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I. The Common Eel *(Anguilla vulgaris, Turton)* gets a particular breeding-dress before its emigration to the sea. — The bearings of this fact on the classification and on the practical eel-fisheries.

By **C. G. Joh. Petersen.**

With 2 lithographic plates.

The common eel gets a breeding-dress which in many, and in part very essential, features differs from the growing-dress. As the systematists have hitherto not understood this correctly, and the various forms of eels, therefore, have been misconstrued in many ways, I shall here render a somewhat closer account of the various forms within this species of the eel *(Anguilla vulgaris, Turton)* and show their mutual relations and bearings, as far as my investigations into this matter go.

The Yellow Eels.

When in summer-time we examine the eels caught by our fishermen in the salt waters with seines or on hooks, or when we take the eels in hand as they are speared in our fjords in winter-time, we may be pretty sure that almost all of them belong to the category of eels which the fishermen and fishmongers call the *yellow eels* (»gule Aal«, in Jutland »Vesaal«), i. e. eels in their growing-dress. — In certain fjords, however, towards autumn, particularly in the month of August, we may among the *yellow* eels get others which the fishermen call *silver eels* (»blanke Aal«, in Jutland »Gaardaal«) i. e. eels in their breeding-dress; but if we ask a skillful fisherman to sort out the latter we

may also at this time get a number of eels in growing-dress to examine. – These yellow eels are generally distinguished by rather light colours; the back, for instance, is gray or brownish, often with a shade of a greenish colour *(Green Eels)*, the sides are pale lemon, the belly either like the sides or of a pure white. The large eels of more than 2 lbs. will often vary from this — about which later on.

On the heads of these yellow eels (see fig. 1, 2, 5, & 10) the snout (in front of the eyes) is much flattened, while the width differs very much; the *interorbital space,* i. e. the distance between the upper edges of the eyes, is, I dare say, always considerably larger than the horizontal diameter of the eyes (i. e. of the transparent membrane which covers the eyes), and in larger eels (25—30 inches long) generally about double that size. When we look at the head from above (fig. 1, 2, 5, & 10 (b)), we see the eyes turned more upwards than sidewards, and the corners of the mouth with the lips can, particularly on the large eels, almost always be seen indistinctly outside the eyes; sometimes the corners of the mouth reach so far to the sides that the head gets some resemblance to that of certain frogs (»the frog-mouthed eel«); this, however, is applicable only to the *larger, lean females* (see plate I, fig. 1 b). The muscles of the occiput in such females are very prominent at the nape on account of the lean, lank body (plate I, fig. 1), and the body is very slim (plate II, fig. 10), while the stomach, however, when it is filled, can be expanded very much by the food. The fact is that these eels are very voracious, and they are caught, particularly in the summer-time, in great numbers on hooks baited with small living fishes: *Gobiidæ (Gobius niger)* or young burbots in their first year; in fresh water other little fishes are used to catch them, for instance the *perch.* As the head does not dwindle down in the same degree as the body when an eel grows thin, and as the eel in this period, in which it eats much, makes great use of its mandibulary muscles, the head of these thin eels becomes strikingly large, and seems still larger than it is. Analogies to this are well known, from codfish as well as from human beings, whose heads become strikingly large when they grow thin. The fishermen then say that »the eels have heads«, and they know very well that this is no recommendation with the fish-mongers; but as these eels are always large, generally $^3/_4$—1—2—3 lbs. a piece, they are paid, nevertheless, far better than the little yellow seine-eels, which often on an average weigh only $^1/_5$—$^1/_6$ lb.

It seems to be the winter, particularly, which produces these lean eels; for they occur in the greatest number as soon as the water is growing warm in the early summer, and are then very voracious. Later in the year they

become gradually rarer, probably because a great many of them have been fished, and the rest are not so thin any more.

These large, yellow, »broad-nosed« eels have among the fishermen at various places particular names, such as »*Klæpaal*«, »*Bredpander*«, »*Bredhoveder*«, *Prokuratorer*« (i. e. »*lawyers*«). Also outside Denmark the fishermen give them special names, in Sweden for instance »*Slukål*«, in Germany »*Dickkopf*«, »*Ramskopf*«, or »*Tanzmeister*«, the latter evidently on account of their thin, lean body, in England »frog-mouthed eels«, »*grig*«, or »*glut*«, etc.

These eels have by several, especially earlier, authors been raised to the honour of being a particular species or at least a variety (*Yarrell* and *Krøyer*, etc.), but as the bulk of them is only represented by *females* it will be seen from this reason already that this view is untenable. Though I have seen many hundreds of these large-headed and thin eels, I never succeeded more than anybody else in finding males among them, so numerous or so strongly marked »frog-mouthed« eels that they together might be supposed to represent the males of this species. Also other characters speak very distinctly against the above-mentioned view, and particularly the fact that the ovaries of these frog-mouthed eels as a rule are but little developed, being at about the same stage of development as those of all other yellow eels. To this matter, however, I shall return later on.

The frog-mouthed eels are found in great numbers both in salt and in fresh water; the value of those taken in our little fjords during the summer is certainly considerably above 100,000 Kroner, so that they are exceedingly common at certain seasons, *both in fresh and in salt water*.

By comparing the figures 1 & 2, plate I, we shall see that the large yellow female eel is very like the smaller female eel; the characteristic flat snout, the small upturned eyes, the inconsiderable height of the body over the pectorals, the light-coloured pectorals rounded behind, are common to both of them, and in these characters they resemble all other yellow eels. The latter may be recognized also by their thin skin in which the scales are but slightly visible; nor do we find, in the skin, many of those small silvery particles *(guanin crystals)* which are so exceedingly prominent in the silver eels, so that the principal colours of the skin are only dully-white, yellow, or, where these colours are covered with the black pigment-cells, more or less dark; always without any noticeable metallic lustre. — The lateral line and its ramifications are visible, but not by far so distinct as on the silver eels.

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The appearance of the male yellow eels (plate II, fig. 5) is in all essentials like that of the females. I have been unable to find any good external characters except in the size, which can serve to distinguish yellow males from yellow females. When authors as *Möbius* and *Heincke* (»Die Fische der Ostsee«) speak of a difference in the size of the eyes of males and females, this holds good of silver eels only, and these only seem also to have been the basis of their pictures. *Robin* (»Journ. de l'Anat. et de la Phys. 5. Ser. 1881«) also seems to know males in breeding-dress only (»pimpenaux«). *L. Jacoby:* »Der Fischfang in der Lagune von Comacchio. 1880. (Berlin.)« mentions, p. 40, several external differences between males and females, among which however he particularly lays the stress on the difference in size as the most important one. (More of this under »The Silver Eels«). He then mentions that the *tip of the snout is broader* in the females than in the males; that this character is quite unreliable will be seen immediately when we look at fig. 6, plate II, nor have I ever found it confirmed by my investigations; to be sure the males may sometimes be very sharp-nosed (fig. 7, plate II), but as to the form of the snout and the interorbital space there is so great variation within both sexes, that it can scarcely afford any reliable character. — *Jacoby* then mentions that the females at Comacchio differ from the males in their colour, and that »ich fand zuweilen völlig broncefarbene Aale, stets mit dem *Syrski*'schen Organ«; I have the impression of his description, loc. cit. p. 50, where he says »der vollständig ausgebildete weibliche Aal . . . Bauch weisslich-gelb, wenig oder kein Metallglanz . . .«, that the emigrating female eels he has seen are not fully developed silver eels, but that on the other hand, the males may be so. In our seas the fully developed female eels have a strong metallic lustre, and are not in the least inferior to the males in this regard.

His next distinctive mark between male and female is the *height of the dorsal fin.* It is very possible that there is a slight difference here; it seems so. Whether *Jacoby* has here compared yellow males to yellow females, or whether there may possibly be any difference in this regard between the Italian and the Danish eel, I do not know; but to this external character I have been unable to attach much importance, especially as it is not easy to measure accurately.

At last, and *as least applicable* as a distinctive mark between the sexes, he mentions the *size of the eyes;* the reason of this is evidently that he has had both yellow males and silver males before him, the former with small eyes the latter with large ones.

Many other authors have mentioned the male and female eels, but none of them, as far as I know, has pointed out any other external distinctive marks than those mentioned by *Jacoby;* of these (with respect to the yellow eels) I have only been able to use *the size*: I never found any males larger than c. 48 ctm. in total length, while the females can grow much larger and are, when full-grown, between 0,5 and 1 meter. As already mentioned before *the broad head* (not the broad front [large interorbital space]) with the expanded jaws and the upturned eyes is, moreover, characteristic of the large, yellow thin females.

As I have said, the yellow males agree, externally, very closely with the yellow females of the same size, so closely that it is quite impossible to distinguish between them with certainty, when they are so young that we cannot distinguish between them by an examination of their sexual organs. On the other hand, when the eels have reached a somewhat considerable size, we need only cut them open and with naked eyes look at the sexual organs in order to decide the question: male or female; but when they are only 10—11 inches this will often already be difficult; a drop of spirit dropped in the eel just as it is cut open will then, as yet, frequently be able to help, but with smaller specimens this will be of no avail any more. By careful microscopical investigations *F. Trybom*, however, has been able to point out unquestionable eggs in eels of 207 mm (c. 8 inches) in length. (»Fisket i Halland 1893, Bilag I«, p. 42). Under this size it must be looked upon as impossible with any certainty to distinguish between the male and the female by means of either external or internal characters.

At about this length, c. 200 mm, the eels are getting their scales, till then they have been naked. The scales appear first near the lateral line; they are rather longish and have streaks showing later additions, which in number correspond pretty closely perhaps to the years gone by; this, however, needs further investigation. Already before the scales appear, the eels have the yellow colour on the sides, and the scales, which lie deep in the skin, do not change the appearance of the fish very much.

As it is well known *the fry of the eel* occurs on our shores when very young, but though I have made careful researches I never was able to find fry smaller than c. $2^1/_4$ inches (c. 6 ctm.) in length; I must suppose, and have done so long, that all former statements of eels as thin as »a string«, »a darning needle«, etc. rest on a mistaken estimate. When *Jacoby*, loc. cit. p. 61, mentions fry of eels in the Italian rivers only 6—8 mm long, this statement evidently arises from *Coste:* »*Voyage d'exploration sur le littoral*

de la France et de l'Italie 1855«, where, p. 58, is mentioned fry of eels 7 mm long and, p. 60, fry of 1 centimeter. Strange to say this mistake, which I think originally arises from confounding 6—7 ctm. with 6—7 mm, has not been corrected till quite lately by *Grassi* and *Calandruccio* in *»Boll. dell' Accademia Gioenia de Scienze Naturali in Catania. — Fasc. 37. Marzo 1894«*, in which we are informed that their explorations at *Comacchio* as well as at *Pisa* and in *Sicily* have proved »che non esistono anguilline di montata di lunghezza inferiore ai cinque centimetri«.*) — They have consequently among the ascending eels been unable to find any under 5 ctm., c. 2 inches, in length; our eels then are nearly as small. —. The Italian authors no doubt are right in this, and we hope soon to get further information as to their explanation of this fact, viz. that the eel has pelagic eggs which are shed in the sea, where the young ones undergo a metamorphosis (the larvæ are *Leptocephalus brevirostris*) which is not concluded till they have grown 5 ctm. long.

The pelagic eggs and fry of eels are not known here in the north; on the other hand the immigrating young eels of $2^1/_4$—$2^1/_2$ inches in length are very common. Before they appear at the mouths of our rivulets in spring, we may sometimes meet them in the deeper, northern parts of the Sound where, personally, I have once got one in a scraper, and whence *P. Willumsen*, the fisherman, has got me some from the stomachs of fishes. At first when they arrive at the shores they are without any pigment in the skin, later on the pigment appears, and already in the course of the first summer the y look very much like the larger yellow eels.

The *sexual organs* of the yellow eels are but very little developed; the *testicles* particularly are very small, though the formation of the lobes is distinct in those over 12 inches in length. — The *ovaries* are somewhat more developed, and *Jacoby's* description of the »sterile Weibchen« (loc. cit. p. 46) is in the main very characteristic of them, when he says that the ovaries are thin ligaments, without any fat, slightly folded up, not rarely transparent like glass, and of the same length and breadth**) as in the other eels (viz. the silver eels). But he is quite wrong when, following the supposition of

*) After this was written I have seen in »Mittheil. des Deutschen Seefischereivereins« No. 1. 1895, p. 24, that Dr. *Seligo* has noticed the same erroneous, old statement of the length of the young eels.

**) The breadth of the ovaries in the little yellow females, on the other hand, is considerably smaller than in the silver eels.

v. Siebold, he calls these large yellow eels *sterile;* they are no more sterile than all other yellow eels that have not spawned before, and it is amusing to see his scientific indignation against the lagoon-fishermen, who have the same word »*Pasciuti*« for the large, frog-mouthed yellow eels as well as for all the little yellow eels, males as well as females. »*Pasciuti*«, in the mouth of a lagoon-fisherman, is (according to *Jacoby*) exactly the same as »yellow eels« in the mouth of a Danish fisherman. The scientific justice of this appellation has long been overlooked, and *Jacoby* overlooked it completely. — I shall not decide whether *Jacoby's* translation of the word *Pasciuti* is correct, but if the fishermen at Comacchio really have a common name for the eels »which do not migrate, which in autumn do not go to the fishing-gear, but which eat all the year round«, then this name suits very well the eels in growing-dress. *Jacoby* has not imagined the possibility that the »sterile Weibchen« should be able to change their outer appearance, as he did not know that also the eel has a particular breeding-dress; as a matter of course, therefore, he could not agree to using the same appellation for these large females and for the young »normal« eels, which also comprise all the later on migrating ones*).

It still remains to mention the very peculiarity which has been

*) The above view of the frog-mouthed eels as large, normal, yellow females, which quite naturally presents itself when we compare their sexual organs with those of other yellow eels, and when we see that the yellow eels change into silver eels, I have set forth for the first time in a preliminary note in »Dansk Fiskeriforenings Medlemsblad«, November 1893. In a way we might certainly call these eels (as on the whole all yellow eels) »sterile« since they have never bred, but this use of the word, nevertheless, is not allowable.

In »Zeitschrift f. Fischerei« 1893. No. 4 (which I know only from an extract in »Svensk Fiskeritidsskrift«. 1893. 153—156) *E. Sennebogen-Comisa* mentions an experiment he has made with the breeding of female eels; he thinks he has seen that large, yellow-coloured, broad-nosed, small-eyed female eels have changed their outer appearance, and that their ovaries took the appearance of those which we find in common eels.

He himself seems to doubt, however, whether the experiment has been made under sufficient control.

After the above has been printed I see that the Italian ingeneer *G. S. Ballo* in his *Previsioni sulla Laguna di Comacchio 1894*, which he has sent me, and which chiefly turns upon the solution of practical questions attached to this great »embanking-undertaking«, has observed (p. 7) that »*Le anguille discendono spontaneamente al mare quando abbiano vestita un'apposita divisa di colore più lucido con ... Gli empirici coltivatori le chiamano allora anguilla femenali o meglia bisati femenali.*« — consequently that the eels get a particular dress when they emigrate to the sea, i. e. become silver eels; and p. 62 *Ballo* says »*mentre quelle che non andavano al mare (pasciuti) vennero trovate, secondo l'Jacoby con ovaia* **abortita** *e secondo quanto io credo, sono anguille con ovaia embrionale*«. He supposes then correctly in contradistinction to *Jacoby* that *pasciuti* (the yellow eels) are eels with embryonal (youthful) sexual organs.

pointed out by the lagoon-fishermen, viz. that the yellow eels *eat so much:* for in this they distinguish themselves from the silver eels, and it is such an important thing that it has a great influence on the digestive organs of the eel, and through those on its whole outer appearance. — It has been mentioned already that the yellow eels can be caught on hooks, but that the silver eels comparatively rarely are caught on them; already this fact tells of a different appetite in the two forms. When many thousand hooks, baited with living small fish or dead sticklebacks, pieces of various fishes, prawns *(Palæmon),* shrimps *(Crangon),* or worms, are set out daily (or rather nightly) and the yellow eels always form the great majority of the catch, this must be explained by the much greater voracity of the yellow eels, a fact which is fully borne out when we examine the contents of the stomachs of eels which have been caught in other ways; the silver eels generally contain nothing, though it may happen, particularly when the eel has perhaps not quite finished the change of its dress. When it is migrating, and in its full, characteristic dress, I never saw any food in its stomach. The yellow eels, on the other hand, can often be so crammed with food, consisting of small fish, or (when they are younger) little snails, crustacea, annelida etc. that their stomachs are dilated so much that they are quite shapeless. This however is seen only in the warmer season; in winter the eels do not eat so much. —

We can also directly see that the digestive organs of the yellow eels work powerfully; for they take up much more room than in the silver eels, even though the stomach and intestines are empty of food. This slight size of the liver, stomach, and intestines in the silver eels makes the eels feel hard, they are more difficult to hold, and the anus is never dilated but »closed« as the fishermen say. — The following table of weighings is given, partly to point out this shrinking of the digestive organs of the silver eels, and partly to show that the sexual organs on the other hand (particularly the ovaries) are somewhat stronger developed in the silver eels than in the yellow ones.

Yellow females.			Yellow males.		
Total weight.	Digestive organs and air-bladder.	Sexual organs.	Total weight.	Digestive organs and air-bladder.	Sexual organs.
385 gram.	40 gram.	2_{5} gram.	125 gram.	c. 10 gram.	Less than 1 gram.
250 —	27_{5} —	2 —	110 —	10 —	1 —
235 —	20 —	2_{5} —	90 —	7_{5} —	1 —
175 —	24 —	Less than 1 —			
165 —	17_{5} —	1 —			
160 —	20 —	1 —			

Silver females.			Silver males.		
Total weight.	Digestive organs and air-bladder.	Sexual organs.	Total weight.	Digestive organs and air-bladder.	Sexual organs.
340 gram.	c. 11 gram.	$6_{,5}$ gram.	121 gram.	c. 5 gram.	Less than 1 gram.
245 —	- $8_{,5}$ —	$4_{,5}$ —	106 —	- $3_{,5}$ —	- - » —
225 —	- 7 —	$3_{,5}$ —	101 —	- 6 —	- - » —
180 —	- 6 —	3 —	92 —	- $4_{,5}$ —	- - » —
160 —	- $5_{,5}$ —	$2_{,5}$ —	86 —	- 4 —	- - » —
			83	3	- »

I have mentioned several distinctive marks, both external and internal, which distinguish the yellow eels from the silver eels, but it must be said also that these marks pretty often are insufficient, and that we are therefore sometimes left in doubt whether we are to place an eel in the former or the latter of these categories. This is oftenest the case with large female eels; we can here easily find all transition-forms from yellow frog-mouthed eels to shining fully characterized silver eels: to this I shall return later on. But also among the smaller eels transition-forms can be pointed out, particularly in salt water in after-summer.

The Silver Eels.

What before all characterizes the silver eels is the form of their snout and the situation of the eyes on this (fig. 3, 4, 6, 7, plates I & II). The snout before the eyes is not quite flattened in the silver eels as in the yellow ones, but it is high and a little compressed, probably owing to the considerable development of the olfactory organ and the size of the eyes. Among the males (fig. 6 & 7, plate II) this height of the snout is exceedingly striking, but a comparison between the large yellow females and the large silver females shows something similar.

This, evidently, is the basis of *C. U. Ekström's* 2 species: *Muræna oxyrhina* and *Muræna plathyrhina*, of which the former corresponds to the silver eels, the latter to the yellow ones; the former, moreover, has a small, the latter a larger anus. They are evidently rather based on the fishermen's knowledge than on *Ekström's* own investigations, and the fishermen always distinguish (in all countries) between the yellow and the silver eels. The zoological view on the species, on the other hand, is all the same to them. That many other authors have looked upon this different form of the snout as a specific character will be mentioned afterwards.

The situation of the eyes of the silver eels is such that they, when we look at the head vertically from above (fig. 3, 4, 6, & 7 (b), plates I & II),

generally protrude before the lips, so that the latter cannot be seen outside the eye, but this forms a part of the outline*); this can be expressed also by saying that the eyes of the silver eels look more to the sides than those of the yellow ones, which look more upwards. The eyes of the silver eels, moreover, are much larger than those of the yellow ones, the largest diameter of the eye, the horizontal one, oftenest exceeding half the interorbital space, and in the males even very nearly equalling the whole interorbital space, and sometimes (fig. 6 a) being longer than the snout before the eyes. Among the females, however, there is much variation in the latter measure, so that the eyes are the larger in proportion to the breadth of the front the smaller the eels are; this evidently is nearly connected with the fact that the interorbital space is greatest in the large eels. In order to show the extremes among the large eels, two such of $30^1/_2$ and $35^3/_4$ inches in length are represented (fig. 3 & 4, plate I), the latter with a broad front, the former with a narrow one. Though the difference in the size of the eyes in proportion to the interorbital space here is very distinct, such a difference is not very striking when the diameter of the eyes is compared to the length of the snout. The form with a narrow interorb. space, however, has decidedly somewhat larger eyes than that with a large interorb. space.

Among the males of the silver eels there is, as shown in fig. 6 & 7, plate II, great difference in the form of the head; but the diameter of the eyes is always nearly or exactly as large as the interorbital space; the tip of the snout, on the other hand, is now pointed, now snubbed, and there can, upon the whole, be a very considerable difference in the size of the head; but in no case of which I know can we find an appearance which, like that of the females, resembles the appearance of the frog-mouthed eels (fig. 1, plate I).

There is no doubt that fig. 4, plate I, represents a female eel whose head when it was younger has looked something like that of the frog-mouthed eel represented in fig. 1, plate I. The changes which have taken place in it since then are chiefly the following: The head before the eyes, where the olfactory organ lies, has grown higher; the eyes have become several times larger in volume, and have turned in such a way that they look more to the sides; the head, upon the whole, has become fatter and plumper. The lower jaw seems to have grown a little longer by the formation of a soft point at its foremost end; the occipital muscles are no longer protruding, for the whole body of the

* This is still more conspicuous before the eels are placed in spirit; all the figures, nevertheless, show the same, though they have been drawn from eels which are kept in spirit

eel has become round, fat, fleshy, and much higher than before; compare particularly the height above the pectorals in order to have a basis for the comparison; the profile of the occiput has thus become quite another. It seems that the lips generally become a little smaller while these changes take place, but it is difficult to decide this question on account of the great individual variation; one thing however has remained unaltered: the interorbital space. On the whole, I do not believe that this transformation of the head extends to the bony cranium; it is certainly the soft parts only which produce the whole transformation from frog-mouthed eel to silver eel.

It will surely be granted that this transformation from an appearance like fig. 1 to another appearance like fig. 4 is striking, and it will easily be understood that the fishermen have noticed these two forms, or more correctly, the former of them; for they do not distinguish the latter from other silver eels with a narrow interorbital space; they all go by the name of sharp-nosed eels; for between fig. 3 and 4, plate I, there is neither habitually nor gastronomically the difference as between these and the frog mouthed eel, fig. 1.

If we look at the heads of the smaller eels which are represented (also the males), we shall observe that some similar changes have taken place; it is here particularly the enormous eyes which tend so much to change the appearance.

We must not imagine, however, that it is only the membrane covering the eyes which grows larger in the silver eels; already fig. 6 a, plate II, shows that the profile has directly changed its form by an enlargement of the apple of the eye, and by taking out the eyes I have seen, moreover, that the very apple of the eye really grows larger. By weighing the eyes after they were taken out and, as well as possible, cleared of the appendant muscles and nerves, I found in a yellow and a silver female eel of respectively $20^3/_4$ and 20 inches that the eyes of the yellow eel weighed 75 mgr. (and measured $5^1/_2$ mm), and that those of the silver one weighed 170 mgr. (and measured $7^1/_2$ mm, and in a yellow and a silver male eel, both $14^1/_2$ inches in length, that the eyes of the yellow one weighed 40 mgr. (and measured 5 mm), and that those of the silver eel weighed 80 mgr. (and measured 6 mm). These were far from representing extreme cases, rather below the average.

On the said figures representing heads of yellow and silver eels we can further see that *the ramifications of the lateral line* are more distinct on the silver eels than on the yellow ones, and that the *pectorals* of all silver eels, though somewhat varied in form, undoubtedly are more pointed behind than those of the yellow ones, and that they, compared to the length of the head, are longer on the former than on the latter; further, the pectorals of the yellow ones are bright-coloured, those of the silver eels dark, even black.

This difference between the pectorals is a very constantly returning distinctive mark between silver eels and yellow ones, and the fishermen in the Limfjord know, for instance, very well how to distinguish »bluefins« from the yellow eels; they know that in years when there are many »bluefins« there will be a good weel-fishery of silver eels.

The 3 figures 8, 9, & 10, plate II, are intented to illustrate the difference in the form of the body of a silver eel with large interorbital space, a smaller silver eel with narrow interorbital space, and a lean yellow eel. The thick fleshy, firm body, which is much higher than the head at the occiput, characterizes the two silver eels at first sight; the thin and lank body with the proportionally large head of the yellow one differs considerably from them; the yellow eels, however, are fortunately not always so lean as this. The specimen represented in the figure has a large interorb. space.

With some practice it is easy when we take hold of an eel, even with our eyes shut, to perceive whether we feel the hard, powerful body of the silver eel or the soft, lean, often lank body of the yellow one, in which as above mentioned the intestines take up a proportionally large room, while the muscles are but of slight importance.

Of other characters which mark silver eels in general, but which cannot be seen from the figures, must be mentioned that the colours on the back of these eels as a rule are very dark, nearly black; then follows on the side a bronze-coloured streak, broader or narrower, which stretches along the fish in nearly its whole length; it may be very little developed, but when it is there, it is very striking on account of its bright metallic lustre. The rest of the sides, as also the whole of the belly, is, I dare say, in all eels when they are just caught, of a pure silver white with the brightest metallic lustre. The dorsal and the caudal fins are dark, the greater part of the anal fin on the other hand light-coloured, often with a red flesh-coloured tone. The fins have no metallic lustre.

Under special circumstances, however, other colours than the above mentioned may occur, the eels, like most other fishes, being able to change colour quickly.

In the Lesser Belt for instance I have seen many eels whose back was of a pale bluish-gray (nearly like dry clay), but this colour I have seen only on eels which had lived in a weel for some time, and it disappeared in the course of a day when the eels were placed in a well. The light colour is produced by a contraction of the pigment-cells in the skin, which on the back quite cover the scales, but which are found also in numbers down the sides and on the belly. On eels which have long been imprisoned I have often seen these pig-

ment-cells spread into dark spots on the belly and sides, and the phenomenon can expand over the whole of the belly and sides so that they become quite dark-gray: »der graue Aal« of the German smoking-places. (See *Möbius* and *Leth* later on.) When the eels are fully developed silver eels there is not the slightest yellow on them.

The outlines of the *scales* are more distinct than on the yellow eels, though they are quite covered by the »silver lay«.

The tubes of the *lateral line* and its round openings show distinctly along the whole body, dark on a light ground; also on the head its ramifications, as above mentioned, are more distinct than on the yellow eels.

The *skin* itself is thick and firm, owing particularly to a strong development of the bluish fibrous tissue of the corium.

While we have »yellow« eels of all sizes, from the eels have any colours at all and upwards, there are known in Denmark *no silver eels under 29 ctm. in length,* and silver eels of such small size, moreover, are very rare; besides they are all of them males. The *smallest* females I have found are 42 ctm., and they are rare too; it is always easy to see, even without any microscopical examination, whether these eels are males or females, and their sexual organs are stronger developed than those of yellow eels of the same size. No doubt, however, much is wanting before eggs and spermatozoa are ripe, nay the latter have never been seen in testes as yet; but the eggs are unmistakably present.

The testes of the silver eels are always distinctly lobated, though the lobes, as I think, never exceed 3 mm in breadth, if they are so broad as that; also the testes of the yellow eels are often distinctly lobated, but it is certain that the formation of the lobes of the silver eels as a rule is more advanced than in the yellow ones.

The *ovaries* are never half-clear, or half-transparent, in fully developed silver eels, as they generally are in all genuine, yellow eels; on the contrary, they are whitish, opaque, with a yellowish or reddish tinge; they are to a high degree filled with fat, and the diameter of the eggs often reaches $0,_2$ mm, or even more, $0,_{26}$ *(Lilljeborg)*, a size I never saw in yellow eels. The ovaries, moreover, are plumper, more folded, broader, and doubtless nearer ripeness than those of the yellow eels, though, certainly, they are still far from being

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ripe*). As to the size of the eggs in the ovary of the eel I shall refer the reader to the above quoted work by *Trybom*.

Which is the Relation between the Yellow Eels and the Silver ones?

Having pointed out the differences between the yellow and the silver eels, and shown that these two forms of eels as a rule really do appear pretty well distinguished in nature, and that the specimens within either group are closely connected by similarity in several essential anatomical characters, in which they differ from the specimens within the other group, I shall state the reason why these two groups ought not to be looked upon as different varieties or species, and show that they are much more closely connected.

*) Note: In the literature, from both earlier and later times, we find accounts of eels with almost ripe ovaries. *H. Rathke*, for instance, in »Müllers Archiv 1850«, p. 203 seq., mentions an eel whose length was 16 inches 6 lines, whose circumference was 4 inches 6 lines, whose ovaries were very plump and $1^1/_2$ inch broad, but whose eggs were only at most $0,_{0018}$ inch (consequently but a little more than $0,_1$ mm) in diameter. Though *Rathke* in other eels has seen eggs of double that size, without the ovaries being plumper than usual, he looks upon the above mentioned eels as »hochträchtig», and says of it: »Ohne Zweifel würde sich bei dem Thiere, wenn es am Leben geblieben wäre, die Eier nach kurzer Zeit von den Eierstocken abgelöst haben«. Well, what is »kurzer Zeit«? And are the eels with the large eggs not still nearer spawning than this? That *Rathke* found one of the lobes of the ovary pressed out through the genital opening does not seem to me to indicate that the breeding time is near; the size (the smallness) of the eggs indicates that it is far off, as far off as in a great number of common eels. *Rathke* does not inform us whether the eel was silver or yellow, but its inconsiderable total length, just like that of the exceedingly rare silver females of the very smallest size, indicates that it was yellow. The eel was brought to *Rathke* dead, in May (the 24th).

I should have been rather doubtful as to this eel, if I had not a few years ago, among a number of eels which had been speared in spring, found a specimen which in many ways agrees with it. *It was a yellow eel*, c. 16 inches long, c. 3 inches in circumference, with thickly folded and very plump ovaries, whose greatest breadth is c. 1 inch, and whose eggs vary in diameter between $0,_{03}$ and $0,_{09}$ mm, an eel, consequently, which in many respects reminds us of *Rathke's*. As this eel is yellow, its breeding time, of course, is still far off, which is also very clearly indicated by the small size of the eggs; as the eggs are much smaller than in most silver eels, I must look upon *the strongly developed folds in its ovaries and the accompanying great number of eggs, as an abnormal development*. Such eels are rare; besides the two above mentioned I have seen only one more, an eel from the Lesser Belt, caught in a weel in December 1888 (cp. »Fiskeritidende« 1888, No. 51, p. 406); it was 23 inches long, and the eggs at most $0,_{125}$ mm. This scarcity, I think, agrees very well with my supposition that these eels with thickly folded ovaries are abnormal specimens.

Though I have carried on my investigations through several years, and had the most ready help from fishermen and fishmongers, I have, as above mentioned, *not succeeded in finding males of silver eels under c. 29 ctm.*, and *none larger than c. 48 ctm.;* I have seen *no yellow males larger than c. 44 ctm.*, but I have seen them so small that it has barely been just possible to decide the male sex.

How it is in this regard with the »Freshwater Eel in a Ripe Condition« caught 12 English miles south of Eddystone, and mentioned by *W. L. Calderwood* »Ann. Mag. Nat. Hist (6) 12 1893«, p. 35, I cannot tell, as the diameter of the eggs is not stated; we are only told that the eggs are »*apparently quite ready to drop*« . »*however*« . . . »*the nuclear membrane was still distinctly visible*«.

I must therefore remain doubtful as to these breeding eels, mentioned by *Rathke* and *Calderwood*, as also with respect to a number of other cases in which, for instance, the breeding of the eels has been observed in fresh water, etc., and which I think it unnecessary to mention any further here.

An eel which is mentioned by *A. Feddersen* in »Dansk Fiskeriforenings Medlemsblad« 1894, p. 466, and of which it is said that »it lies near to look upon it as a spent female« I shall here mention somewhat closer, as Mr. *A. Feddersen* at my request has been kind enough to permit me to examine it.

Its remarkably emaciated appearance is evidently the most striking thing in this eel; for its bones are not brittle, as Mr. F. mentions; it is only the loosening of two vertebræ by the bending together of the thin tail, which made Mr. F. think so, and as to the »emptiness« of the ovaries, a microscopical examination of them showed that they contain many eggs, chiefly of the same size and outer appearance as those of other frog-mouthed eels of this size (65 ctm.). It cannot be denied, however, that the fatty substance in the ovaries, and in the whole eel, was reduced to a minimum, which, together with the bad state of preservation, gave the interior parts a somewhat uncommon appearance. If the eel had spawned, we might either have expected to see the ovaries quite empty of eggs, or among the remaining ones have been able to point out larger eggs which were not dropped, as it is common to see in spent fish; but of this I found no trace. I must say, therefore, that I think we had better stick to the second possibility which Mr. F. mentions: that the eel is a »starved or sick specimen«, much the more so, as I have observed that the skin has been scraped off, and most of the scales lost, at a certain place round its body, which might tend to show that the eel has somehow been squeezed, perhaps kept so for a long while. This hurt is quite different from those which, in the form of streaks or scratches, may be seen on many of the large silver eels, which towards the end of the fishing-season are caught in the Lesser and the Great Belt. Whence these »scratched« eels come, and how the scratches arise, I cannot tell; but it is a phenomenon which returns yearly with great regularity, and which is looked upon as indicating the approaching end of the fishing-season; these scratched eels are not lean as the Ringkjøbing-eel. It lies near to ask whether the said eel is »silver« or »yellow«, and we might be tempted then to answer, that it is black, i. e. it is neither yellow-coloured or of a metallic lustre, and its whole appearance makes it impossible to decide by means of the usual characters, whether it is to be referred to one or the other of these categories.

Silver females I have not seen under c. 42 ctm, but probably they may be found a little smaller, though but rarely; the largest eels, on the whole, which I have seen, have been silver eels. *Yellow females* I have seen so small that it was just possible to decide the sex; more difficult is it to state their limits upwards, as I have already mentioned, because the larger female eels, over c. 78 ctm., as a rule, form the transition between yellow and silver eels.

It will be seen that these size limits for the sexes agree in such a way that the supposition that the yellow eels are »the young ones« of the silver eels lies very near, and the fact that no silver eels are found here *under* the said lengths is, I think, sufficient to warrant our looking upon this supposition as the only possible; there are several other circumstances, however, which as decidedly point at the same solution of the question, and which I shall set forth here for further confirmation, viz.:

1) The greater development of the sexual organs in the silver eels.
2) The smaller desire for food among the silver eels and the whole state of their digestive organ during the migration.
3) The periodical occurrence of the silver eels in the waters, their emigration to the sea in summer and, particularly, in autumn, and the fact that the stock of eels in our fjords *in winter* almost exclusively consists of yellow eels.
4) The conclusion of the development from yellow eel with commencing metallic lustre to the fully developed silver eel without any yellow colours I have repeatedly witnessed in cauls in which I kept yellow eels; some of these grew in a few weeks into fully developed silver eels.
5) We find, in nature, eels which in all characters that distinguish silver eels from yellow ones (except the size limits downwards) form transition stages between both.
6) Great numbers of silver eels emigrate every year from fresh waters whose mouth is an artifical lock, where we know, therefore, that silver eels never immigrate, fresh waters that always swarm with yellow eels in all sizes which while they are yellow only emigrate in very small numbers.

From the above reasons I must consider it an undoubted fact that the »silver« eels are eels which have formerly been »yellow«, but now *before* the propagation get a peculiar breeding-dress.

Such a thing has not yet been pointed out within the family of the *Muræniдæ*, except with respect to the *Conger vulgaris* by *Cunningham* (J. Mar. Biol. Ass. vol. II, 1891—92, p. 16) who showed that the eyes of the male by commencing maturity grow very large; other external characters do not seem to have been observed in the *Conger* which might indicate their getting a peculiar breeding-dress, and such a one cannot be said therefore to have been observed.

The peculiarities which have been observed in the *Conger* by the commencing ripeness of its eggs and sperm, make it probable that both males and females die soon after the first spawning-season; this seems to be indicated especially by the peculiarly soft condition of the bones in the crania of the mature fish. Also the considerable size of the eyes of the mature males indicate the same; for we do not see large eyes in immature males, and it is unlikely that they can have dwindled in after the propagation.

Cunningham says of the mature female *Conger* that »*all the eggs are of about the same size*«, viz. about $1—0{,}_{95}{}^{mm}$; must not this also indicate that each specimen has in its life but one spawning-season?

I have formerly, without further elucidation of the matter, spoken of the breeding-dress of the eel, as though it quite corresponded to what we call breeding-dress when we speak for instance of salmon, trout, and other fishes; but, indeed, it does not do so at all. For the salmon gets 1) *a new breeding-dress before each spawning-season*, and 2) it *does not get it till its eggs and sperm are nearly ripe*. But now there is every reason to believe that the eel *only once in its life* gets the said dress, and it gets it at any rate *long before eggs and sperm are ripe*. If, therefore, we will compare the transition of the eel from yellow to silver with anything in the salmon, the nearest thing to think of is the transition of the salmon from »Parr« to »Smolt« and »Grilse« (from a young fish to a grown-up one); for this change occurs but once in the life of the fish, at the same time as the migration instinct awakes, and it is accompanied by a similar transformation, for instance of the skin and its colours, as in the eel. This »dress«, or whatever we now may call it, is never lost in such a way that the skin of the fish again becomes as it was when it was a »Parr«, but during the spawning-seasons it may be further developed into a breeding-dress of rather a perishable condition; for this breeding-dress disappears after every spawning-season. I mean therefore that *the transition of the eel from yellow to silver eel must be compared to the transition of the salmon from a young fish to a grown-up* (afterwards ripe) *one, and not to the changes in the colours of the salmon and other transformations of it during the spawning-season*. When, nevertheless, I call the dress of the silver eel its breeding-dress, it is because

I suppose that *the time for the eel's transition to a grown-up fish is identic with the transition to its only breeding-season.* Whether the silver eel is more strongly coloured or further transformed before the propagation I cannot tell; but the two things: the transition of the eel to a grown-up fish and the transition to its only spawning-season occur at the same time, therefore it can be defended to call the silver eel the eel in *breeding-dress.* I suppose that the eel has only one spawning-period in its life, partly in analogy with what we know of the *Conger,* partly because nobody as yet has ever met with a spent eel; if a scientific man got hold of such a one it would surely be proved immediately by the state of the ovaries and, as far as the males are concerned, by the large eyes.

Till this day this has not happened, not even a fully mature eel has been observed more closely *(cp. ante).* The silver eels on our shores are the most mature eels that are known; and they do not, as the *Conger*, develop their sexual organs, even when they are kept in captivity for a long time. I have kept them in cauls for more than half a year, and have not been able to trace the slightest development. On our shores, as well as on the German shores of the Baltic, ten thousands of living silver eels are wintered yearly in reservoirs of running fresh water, because the price of them rises in the course of winter. These eels often go from September—October of one year till April—May of the next, always without taking any food and without losing more than a few per cent in weight during that time. If the sexual organs could be developed under these circumstances, it must certainly be observed now and then; but in spring, after half a year's captivity, there is no alteration to be seen worth noticing.

That we know of no eels so near the spawning-season as the *Congers* observed by *Cunningham*, agrees also with the fact that the eggs of the eel, even in the most developed specimens, are still small ($0{,}_2$—$0{,}_{26}$ mm), and that the eggs in the same ovary are not all of the same size. After all, it seems to me however, that there is nothing in what we know about the construction of the ovary of the eel, which really does prove that the eel has but one spawning-season in its life, but, on the other hand, there is nothing against it neither (cp. *Trybom*). As yet the facts seem capable of being explained in both ways.

As to the *quickness with which the eel gets its breeding-dress* I shall say only that while the last stages of the latter, the changes of colour, may proceed very quickly, in a few weeks, as I have said already, I cannot tell from immediate observations how long time the whole transformation takes; as however almost all the silver eels disappear from our fjords in winter and reappear towards the end of next summer, the transformation cannot last more than c. $^3/_4$—1 year *in general.* When the silver eels have gone away in autumn, we

may see already among the smaller eels some which evidently begin to get the dress, though they will not finish it quite till next year. Among the large female eels, on the other hand, we find *at any season* specimens which are in transition between yellow and silver eels. I have got the impression that these large eels are a much longer time in getting their breeding-dress than the small ones; perhaps it lasts even several years.

It would be interesting to examine this by placing eels in ponds, where there are no eels previously, as also to examine what becomes of the silver eels when we prevent their migration to the sea, whether they will commence eating again, or whether they will die. The latter is suggested perhaps in a note in »Ann. Scot. Nat. Hist. 1894, p. 183«. I know the note only from an extract; it is said to treat of sick and old eels from a warm lake which has no (?) connection with the sea.

E. Blanchard, in »*Les poissons d'eaux douces de la France*« 1866, pp. 498—501, mentions an eel which for 37 years has belonged to the *Desmarests*. *E. Desmarest,* who was a naturalist at Paris, informed *Blanchard* that this eel was bought in 1828; it measured, in 1865, $1{,}_{30}$—$1{,}_{40}$ meter, and had since 1828 grown about $^1/_3$. It goes on eating, though not much and not at all seasons; in the foresummer it generally gets migrating propensities and wants to jump out of its reservoir.

In 1828 then this eel has already been c. 30 inches long, a very considerable eel; it has for many years been but little voracious, and must certainly have been a silver eel, what its migrating propensities seem also to imply. It appears then that such silver eels, when they are prevented from emigrating to the sea, can continue *to eat and to grow,* and it will be difficult perhaps also in any other way to explain the occurrence of very considerable silver eels (all females of course) in basins of fresh water often of slight extent. At all places where the fishery is carried on very intensely these large eels seem to become rarer, and at last quite to disappear; simply, I suppose, because they are not permitted to grow old and large before they are fished.

On the Opinions of earlier Authors.

It is quite a remarkable thing indeed that is has not long ago been pointed out that the eel gets such a breeding-dress, particularly when we remember

how eagerly the classification of the eel has been studied, or at any rate how much there has been written on it.

On the one hand the *fishermen* have always known that there were two very different forms of eels, the yellow and the silver eels, but we cannot expect them to give a further explanation of this fact; on the other hand most *skillful systematists* have seen that all our forms of eels doubtless belong to one species, and this I think is also correct; therefore they have not cared to enter into a study of the two forms of eels; *other authors* have not seen this and have uncritically set up the forms they have got from the fishermen as species, and have thus got 2, 3, or even more species. In our own literature, for instance, *H. Krøyer*, in »Danmarks Fiske«, has set up 3 species: I. *Anguilla migratoria,* Krøyer, which evidently corresponds to the large, silver eels with a broad interocular space; II. *Anguilla acutirostris?* Yarrell, corresponding to the middle-sized, half silver, still yellow-tinted eels (the figure is taken from *Yarrell* and is evidently a picture of a silver eel), and finally III. *Anguilla latirostris*, Yarrell? corresponding to the meager, yellow eels (the figure from *Yarrell* and representing a frog-mouthed eel).

The latest great Scandinavian work on the fishes, *Lilljeborg:* »Sveriges och Norges Fiskar«, makes one species out of Kroyer's three, and justly so, but without explaining what then is the reason why these forms exist. In England where *Yarrell* in his time in »British Fishes« also set up 3 species: *Anguilla acutirostris, A. latirostris*, and *A. mediorostris*, corresponding to *Blankaal, Klæpaal* og *alm. gule Aal* or *Silver eels, Frog-mouthed eels,* and *Yellow eels,* later authors, as *Fr. Day: »British Fishes«*, 1880—84, have also looked upon these forms as belonging to one species, but without giving sufficient reasons for it; his statements vol. II, p. 242, are partly wrong, partly insufficient. England's well-known ichthyologist *A. Günther,* on the other hand, has, 1870, in his *»Catalogue of the Fishes in the British Museum«,* vol. VIII, tried to distinguish between the two species: *A. vulgaris* and *latirostris;* the latter, evidently, is founded only on yellow females and corresponds exactly to the »frog-mouthed eel«, (»Glut« or »Grig«). Neither the position of the fins, the length of the head, the size of the lips or the eyes, nor the breadth and length of the snout can be used as specific characters, for all transition-forms are found between the extremes. — In France and Germany the authors rather agree in believing in one species of eels in Europe, and *Camille Dareste: »Résumé d'une Monogr. des Poissons Anguilliformes.* Arch. de Zool. exper. etc. Tom. IV. 1875« has arrived at the same result, viz. that the form of the head

and snout is a quite useless character to distinguish between *A. vulgaris* and *A. latirostris.*

Though skillful systematists have thus for a long time held the *opinion* that there is in Europe only one species of *Anguilla,* it will easily be understood that this question could not be finally settled till we got an explanation of the reciprocal relations between the different forms of the eels, and this of course could not be done till the question of sex had been solved, i. e. till both females and males could be pointed out. It is well known that this was done first, in 1874, through the investigations of *Syrski;* what could be done before that time (except the pointing out, or the more correct explanation, of the breeding-dress) seems to me to have been done by *v. Siebold* in »Die Süsswasserfische von Mitteleuropa«, 1863.

v. Siebold says for instance, p. 343: »Der Aal nimmt in seinen verschiedenen Alters und Lebenszuständen mancherlei Formen und Farben an, welche zur Aufstellung von mehreren Aalarten Veranlassung gegeben haben. Eine grosse Verschiedenheit bietet die Länge und Form der Schnauze des Aales, worauf *Risso* und *Yarrell* die drei Species *Anguilla acutirostris, latirostris* und *mediorostris* gründeten. *Ekström* gab der Vermuthung Raum*), dass sich zwei Aalarten unterscheiden lassen, die er als spitznasigen und plattnasigen Aal *(Muræna oxyrrhina* und *platyrrhina)* bezeichnete. Es verstehen sich gewöhnlich die Fischer sehr gut darauf, diese verschiedenen Aalformen herauszufinden. Nach *Cuvier's* Angaben scheinen es hierin die Fischer in Frankreich am weitesten gebracht zu haben, indem sie sogar vier verschiedene Aalarten unterscheiden. Ich muss aus weiter unten anzuführenden Gründen die Art-Berechtigung dieser verschiedenen Aalformen durchaus in Zweifel ziehen.«

His view on the matter agrees here quite with mine.

Page 352 *v. Siebold* says further: »Von der einen dieser Aalformen wird behauptet, dass derselbe, wenn sie auch ausgewachsen sei niemals wandere« . . . »so liegt alsdann die Frage nahe, ob diese niemals wandernden Aale nicht steril gebliebene Individuen sein können« . . . *v. Siebold* has here the yellow eels in view; but he has not thought that they could change their appearance or that their »sterility« is their normal condition.

How far *v. Siebold* is from acknowledging the existence of a breeding-dress is shown by his statement p. 353: »Dass zur Herbstzeit in das Meer hinausgewanderten Aale wirklich dort ihren Fortpflanzungsgeschäft vollziehen,

*) See *ante* p. 13.

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darüber kann kein Zweifel mehr herrschen«, . . . in connection with his statement p. 352: »Es ist ein Beweis mehr, dass die Aale nicht im geringsten für das Fortpflanzungsgeschäft vorbereitet in das Meer hinaustreten«. If besides being an intelligent naturalist he had also been a little more of a fisherman, he would soon have seen that the emigrating eels all had a pecular appearance, i. e. that they were silver eels, eels in breeding-dress.

The author, after 1874, who seems to me to have been nearest to obtain a clue to the difference in the outer appearance between males and females as well as between yellow and silver eels, is *Jacoby*. In »Der Fischfang in der Lagune von Comacchio 1880«, p. 50, (3), he thus gives a very correct description of the little males with a metallic lustre which emigrate to the sea. He says however here »Augen meist gross« though they are *always* large in the silver males; the reason of this, I dare say, is that at Comacchio he has also seen yellow males.

Loc. cit. p. 50, (2), he describes the frog-mouthed eels which he cannot look upon as normal eels.

Loc. cit p. 50, (1), finally, he describes the females, but he says of them: »Wandert im Herbst ins Meer und hört auf zu fressen während dieser Zeit«; they are consequently in autumn strongly marked silver eels, and yet he says of them: »Rücken braun-grün, niemals intensiv schwarz, Bauch weisslich-gelb, wenig oder kein Metallglanz«, and he does not mention the eyes. Evidently he has here had more yellow females than silver ones to look at, and to distinguish between these and unite the yellow ones with the frog-mouthed eels has not occurred to him for one moment, though as above mentioned the fishermen down there so to speak call upon him to do so. Loc. cit. pp. 47—48 he says: »Aus diesem Gebrauch desselben Namens Pasciuto für zwei ganz verschiedene Kategorien, von dessen die eine sämmtliche noch nicht reife, also auch die später wandernden normalen Weibchen und die Aale mit dem Lappenorgan umfasst, die andere sich aber allein auf die sterilen Weibchen bezieht, welche niemals wandern . . . . . ergiebt sich eine Verwirrung, ... die dem Forscher anfangs . . . . Schwierigkeiten bereitet.« This, however, is the way in which all skillful fishermen all over the world have looked upon the eels, and will look upon them also in future; but I think it will no longer cause the naturalists any »Schwierigkeiten«. —

It might seem perhaps that *Möbius and Heincke:* »Die Fische der Ostsee 1883«, pp. 144—145, are still nearer the full understanding; for they know that the fishermen distinguish between »zwei Sorten Aale; den *grauen* und den *gelben* Aal«; they know, finally, that *Leth* has expressed the opinion that

die *graue Farbe des Wanderaals* dessen *Paarungsfarbe* ist«. They do not try, however, to connect these statements with the forms or species of eels set up by the authors, they do not try to find out how »the frog-mouthed eel« is to be understood, and they do not know that the yellow and silver (gelbe und graue) eels differ in many other regards than the colour. Still in 1887 when *Möbius* in his essay on the sexual organs of the eels in »5ter Bericht Komm. Wissensch. Unters. deutsch. Meere«, p. p. 127—157, again returns to the same thing, he speaks but very briefly of *Paarungsfarbe*, and seems, like *Leth*, to mean that just the gray colour is characteristic in this respect (cp. *ante*), and he even mentions that this colour appears in dots.

Though our various forms of eels have thus for many years already been looked upon as belonging to one species, and though the migrating form only (the fishermen's »silver eel«) was supposed to take part in the propagation, while the yellow eel on the other hand was stationary, nobody has *directly written* that it is so before Mr. *F. H. T. Leth*, the lawyer,*) (see »Fiskeritidende« 1882 p. 393 seq.); he has, more than *Jacoby*, represented the fishermen's view of the matter, and he has, moreover, got the idea that one of the forms they have adopted represents the eel in growing-dress, the other the eel in breeding-dress, though certainly without any further satisfactory explanation. I hope that the above statements may be regarded as such.

If therefore in future any one will set up more than one European species of the eel, he must take care that it embraces both males and females, both yellow and silver eels, and that it is founded on something else than the breadth of the interocular space; for this latter character is in discredit; — specimens with a *large interocular space* are to be found, as above mentioned, among the yellow eels as well as among the silver ones; but this is not at all what the authors call and have called *A. latirostris* (frog-mouthed eels), for the sharp-*headed silver eels* with a large interocular space have, as far as I know, never been placed in that category — and as yet no one has successfully tried to distinguish between the silver eels with a small and those with a large interocular space; to do so it is necessary to have other characters. — Nor does there seem to be any difference in the life of these forms of eels, for we meet with the yellow specimens with a large interocular space both in fresh and in salt water, and it is just the same with the corresponding silver eels with a large interocular space; of course, only the silver ones take part in the breeding-migration. But it is a great mistake to believe, as many

*) Consequently 9 years before *Bullo*, the engineer; see note p. 11.

authors do, that the yellow eels do not migrate at all; they emigrate from our fjords and fresh waters and immigrate into them, but often at other times and in other directions than the silver eels; several considerable weel-fisheries have lately been developed on the basis of these formerly but little heeded migrations of the yellow eels.

There has been considerable doubt for some years after the discovery of the male eels (1874), whether they were found in numbers in fresh water or whether the females were nearly sole masters here, a question, after all, of no very great interest, which had got some scientific importance only because their scarcity in fresh water was supposed to be a proof of their inability to breed there; they could do so only in salt water.

Already in 1880, however, *O. Hermes* proved the occurrence of a number of male eels a long way up the Elbe, but as this did not seem to have convinced *v. Siebold* that male eels really and ordinarily do occur in fresh water *Hermes* further (in »Sitzungs-Berichte der Gesellschaft naturforschender zu Berlin 1882« pp. 37—38) set forth a statement of finds of male eels in the Elbe at Wittenberg, i. e. more than 20 German miles from the sea-shore; he found among 600 eels on an average $5{,}_2$ % males, and in order to further remove all doubt he adds: »Dieses Ergebniss ist nicht etwa ein zufälliges, sondern wurde durch die im nächsten Jahre fortgesetzten Untersuchungen von Neuem als richtig bestätigt«.

Afterwards several others have shown the occurrence of male eels in fresh water, and they are known also in our waters. — The places, however, where the males are most frequent, are certainly our little brackish fjords, as for instance Roskildefjord, where I have found them by far to exceed the females in numbers. (See later on.)

On Classification and Foreign Species of Eels (*Anguilla*).

Of course it is not our northern eels only which get such a breeding-dress as that described above; I have seen also at the Zoological Museum a specimen of *Anguilla vulgaris* from Egypt, which was a fully developed silver eel, and the breeding-dress, of course, is found at all places where the species occurs; it is not known for certain whether it is found also in the other species of *Anguilla,* represented by such distinct types as *Anguilla sidat* and *Anguilla labiata,* but it can scarcely be doubted.

Authors as *Bleeker* and *Kaup* have set up a number of species of *Anguilla*, which *Günther* has afterwards partly united, without giving

any other reason than the, after all, very good one, that they were connected with one another by all possible transitions; *Kaup's* European species of *Anguilla*, particularly, have been much reduced in number, from c. 20 to 2 or 1. But though we must agree with *Günther* in this reduction, we want a little more explanation, and the above statements give us some help that way. — It will easily be understood that the size of the eyes and the form of the head can scarcely be good specific characters, as they are dependent upon the breeding-dress of the eel; but in Dr. *Kaup*: »*Catalogue of Apodal Fish* 1856«, p. 32, these very characters are used to mark out the first group of species, consisting of 4. Of these *A. Kieneri* is a questionable *Anguilla* which I shall here leave quite out of consideration (*Fr. Day* has thought to recognise in it a *Lycodes*); the 3 others are little silver (or half-silver) eels, all of them males I dare say, of sizes between $18_{,5}$ and $13_{,6}$ English inches.

Kaup's second group of species is characterized by a more longish snout and a taller dorsal fin, and will thus particularly embrace yellow eels and females; *A. marginata, A. ancidda? A. altirostris,* and *A. platycephala* must thus be looked upon as little yellow eels, *A. latirostris* and *A. capitone* as frog-mouthed eels, *A. morena?* and *A. melanochir?* as silver eels.

It would be a good thing, no doubt, if all the species within the whole family of *Murænida* could be subject to a revision where there were the materials for it; for as long as not the slightest attention is paid to the sex or the breeding-dress of the eels in the descriptions of the species, we cannot expect the latter to satisfy our just demands. This has not been done in any of the more comprehensive works, nor could it be done as these things have not been more closely elucidated till after they were written. In his »Catalogue of the Fishes in the British Museum, Vol. VIII. 1870« *Günther*, in grouping the species within the genus *Anguilla*, tries to avoid such characters as the form of the snout, the size of the eyes, etc., which are known to be subject to great individual variation, but he supposes nevertheless that the groups *α* »Eye considerably shorter than the snout« and *β* »Eye not shorter than the snout« can be maintained. Among *β* he counts only *A. kieneri;* but many of our common male silver eels must belong to *β*, while the females and a number of the males must be classified under *α*. See for instance plate II, fig. 6 a; the snout of the specimen which is represented is even shorter than the diameter of the eye.

On the Size of the Eels in our various waters, and on our Eel-Fisheries.

Everybody who has had anything to do with the *wholesale* trade in eels, knows that the eels which are fished in our Danish waters are not of the same size; that, for instance, the eels we may buy of the fishermen in the Lesser Belt are, on an average, much larger than those which we get from Roskildefjord. This circumstance is the same every year. From the Lesser Belt we can get for instance yellow eels caught in seines in great numbers, of which, on an average, 2—3 go to 1 lb.; in Roskildefjord, on the other hand, 6—8 go to 1 lb. — Something like this applies to the silver eels from these two waters; of the silver eels from the Lesser Belt, south of Middelfart, there generally go 20 to the »Lispund« (= 16 Danish lbs.), of those from Roskilde and Frederikssund (from the fjord) there go 60—80. As the size has a great influence on the value of the eel pr. lb., this is a matter with which the Germans who buy up the eels are very well acquainted, and they have indeed a set price per lb. of silver eels which are bought, depending on whether they are fished at one place or the other. These prices were in 1888 as follows:

48 Øre for silver eels from Klakringen (off Vejlefjord).

45 Øre for silver eels from Fredericia, Middelfart, Assens, Boiden, Horne-Mark, Dyreborg, Faaborg, Svendborg, Thurø, and the neighbouring districts.

43 Øre for silver eels from Ærø, Langeland, and all islands south of the northmost point of Ærø, Nyborg, Kjerteminde, and the interjacent districts.

For silver eels from Kallundborg, Korsør, Skjelskør, Karrebæksminde, and the interjacent districts:

in the first dark of the moon 40 Øre,

in the 2nd and 3rd dark 42 Øre.

These prices were offered before the eels were fished, based on the knowledge which the fish-salesmen had of the quality of the take from former years, and their knowledge is very trustworthy. It will be seen that the whole emporium embraces only the Lesser and the Great Belt, as the trade on the northern shores of Jutland and in the Sound was on other hands. Within this said emporium it is the Lesser Belt which produces the dearest goods, i. e. the largest silver eels.

Such a difference in the average size is found also among other species of fish, for instance among plaice and cod, and it can depend on various circumstances; in certain waters, for instance, there live chiefly fish that are

one or two years old, while the older ones emigrate to deeper places; in other waters there are dwarf-races that become adult at a proportionally small size.

It was clear to me beforehand, however, that these two circumstances could scarcely be the main cause of the different sizes of the eels; for all sizes, to the very largest, are found in fresh water as well as in salt water, and at certain seasons very large eels are found on shallow water near the shore. This very fact that the eel is independent of the salinity, made it improbable that strongly marked dwarf-races of this fish would be found in our seas, and a direct examination of this question gave also another explanation of the phenomenon. The male eels were found to be so rare in the Lesser Belt that only 27 % of the males were caught there in the first dark of the moon which generally gives most male eels there, as at other places, while I got 94 % in Roskildefjord in the first dark and 85 % in the last darks; in these latter darks, into the bargain, there were not by far caught so many eels as in the former, so that the male eels, from this reason also, play a still more dominant part here. As the males, on an average, do not weigh more than c. $^1/_4$ lb. a piece, while the females, as a rule, weigh $^3/_4$—1 lb. and more, it will easily be understood *that the average size becomes smaller where the males are numerous, than where there is but a little number of them. The numerical relation between the sexes is the main cause of the various average sizes of the silver eels in our waters, for a comparison between the eels of either sex from different waters does not show such a difference in size;* c. 18 inches is everywhere the maximum size of the males, and very large females are found in all seas and fresh waters, though certainly not in equally great numbers everywhere. In certain smaller brackish waters, to be sure, it seems that some few eels, both males and females, can become silver eels with a total length which is somewhat smaller than that which is the minimum in more open waters; this, however, seems but slightly to affect the average size.

To get the exact measures here is very difficult, as the fishermen at the various places use meshes of very different widths; and as the Biological Station, on account of the shortness of the fishing-season, as a rule is unable to examine the silver eels with its own fishing-tackle at more places than one in the year, it will last some time before it can get more considerable materials collected, by its own fishery, from all parts of the country.

From this reason I shall not now enter more closely into this matter, but only mention that the numerical relation between the sexes differs very much among the yellow eels also, and that it, to a very high

degree, influences the average size of the eels that are caught; as might be expected, the yellow males are numerously represented in the same waters where the silver males are found in great numbers, and vice versâ.

In a following report I shall return more closely to the conditions which affect the different sizes of the eel in our waters, the correct knowledge of which is of the most vital consequence to our fishery. 30 years ago the size of the eel (of the yellow eels as well as of the silver ones) was another in the Issefjord than it is now, *the cause of which, certainly, is to be found in the intense fishery of later years, when so very few eels can reach any considerable size as they are fished before this is attained.* The yellow eels in the fjord are therefore, on an average, small now, and the silver eels are almost exclusively represented by males.

The above statements, that the yellow eels become silver and emigrate to the sea, and that the so-called frog-mouthed eels are not for ever sterile but also at last become silver eels, are of no slight consequence to our eel-fishery in the more inclosed waters, particularly, consequently, in fresh waters; for, pursuant to this we must suppose that all adult eels voluntarily leave these waters in order to go to the sea, and where we have it in our power to catch *all* the emigrating eels (for instance in eel-trunks, eel-baskets, etc.), the fishery, consequently, ought as a rule to be limited to the catching of these, and fishery with seine or hook ought not to be carried on in the same water, because the expenses become heavier by doing so, while the profit on the fishery in the long run cannot be supposed to become greater, as also because the eels which are caught in this way are not yet adult, nor are they so fat as they will normally become if we waited till they were silver eels. If, at such places, we catch only *all* the emigrating eels, we get what the water in question can give, and, exactly, all that is ripe to be caught. The expensive seines which in several of these waters are used for catching yellow eels, ought certainly not to be employed; by this we shall save money for keeping the fishing-apparatus in repair, or for the crew.

If, on the other hand, we cannot catch all the emigrating eels, but only a greater or smaller number of them, the use of other methods for catching them may be recommendable, and in salt water where, I dare say, only a small number of the emigrating eels are caught, such methods are quite indispensable.

Emigration from fresh and brackish Water to the Sea for the sake of spawning is not an exceptional phenomenon among our fishes.

That the eel in its silver dress emigrates to the sea in great numbers has been known by everybody from time immemorial, and great fisheries and interests have always been attached to this migration; the silver eel goes out of our fresh waters as well as along our shores, *and the yellow eel does not follow it on this migration.* These are long-established facts which in themselves fully prove that the yellow eels become silver, particularly after it had been pretty unanimously agreed upon that we had to do with only *one* species of eels; nobody, however, had taken the trouble more closely to examine this circumstance and show what is hidden behind the fishermen's names »yellow« and »silver«.

The silver eel's great migration has, at least since *v. Siebold's* time, and surely most justly, been supposed to be connected with the breeding of the eel in the salt water, of which, after all, we do not know much; but the brood which in spring has immigrated into the inshore seas and fresh waters is evidence, however, that such a breeding has taken place.

When the direction in which the migration goes has generally been looked upon as *an exception from the breeding-migrations of other fishes,* which from the sea *approach* the shores or go into fresh water, while the eel *withdraws from the shores and the fresh water,* this is in my opinion quite unjustified. The breeding-migration of the eel fully agrees with the migrations of several others of our commonest salt-water fishes, for instance *plaice* and *flounder.*

That fishes as *trout, salmon,* and various others, which spawn in fresh water, during the breeding-time go up the rivulets and brooks from the sea cannot surprise; they must be looked upon as *fresh-water fishes* which have accustomed themselves in certain periods of their lives to seeking their food in the sea; but by their breeding and their tender fry they are firmly attached to fresh water which, therefore, they cannot at all dispense with.

Equally easy is it to understand that *salt-water fishes* as the *herring and* the *garfish, whose eggs are deposited on the bottom of the sea on shallow water,* in breeding-time generally *approach the shores,* as their eggs and fry cannot live at any other places.

That fishes whose eggs, on the other hand, *float or buoy in the water* also must go to such places as are suitable for the development of their eggs, i. e. places

where the specific gravity of the water is high enough to bear the eggs, i. e. where the water is salt enough, is a fact of which we generally do not think, and it was therefore a surprise to me to see, that both the *flounder* and the *plaice*, which at times are common in our small, half-brackish fjords, before the breeding-time leave these and, consequently, *withdraw from the shores and the fresh water*, where they often go up, when little ones, to seek more open and salt water, *just as the eel does.*

Such a breeding-migration from the inner fjords to the more open sounds and shores takes place also among fish without pelagic eggs, for instance *Spinachia vulgaris*, which is very fond of staying in the enclosed fjords, but in breeding time always emigrates to the clearer waters with more rapid currents at the mouths of the fjords. It is then not at all an exceptional or inexplicable thing that the eel goes into the enclosed waters during its growth and leaves them before it becomes mature, it is only the *greatness of the phenomenon* which is uncommon, as the eels appear in such great numbers and many of them not only go up the small brackish waters but even into the fresh waters which are often at a long distance from the sea. *The eel must, no doubt, be looked upon as a salt-water fish, just as well as the flounder or the plaice.* For them all, considered as species, the salt water is quite necessary, and only during their growth some specimens go into fresh water.

Copenhagen, in the spring, 1895.

Explanation of the Plates.

Plate I, fig. 1 a-b. Head of a 27 inch. long yellow eel with large interorbital space ♀ in $^3/_4$ linear size.

— - 2 a-b. — - - 19 yellow ♀ eel in $^3/_4$ linear size.

— - 3 a-b. — - - $35^3/_4$ - - silver eel with small interorbital space ♀ in $^3/_4$ linear size.

— - 4 a-b. — - - $30^1/_2$ - silver eel with large interorbital space ♀ in $^3/_4$ linear size.

Plate II, fig. 5 a-b. — - - $14^1/_2$ - yellow ♂ eel in natural size.

— - 6 a-b. — - - 16 silver ♂ - - — -

— - 7 a-b. — - - $12^3/_4$ - silver ♂ - - — -

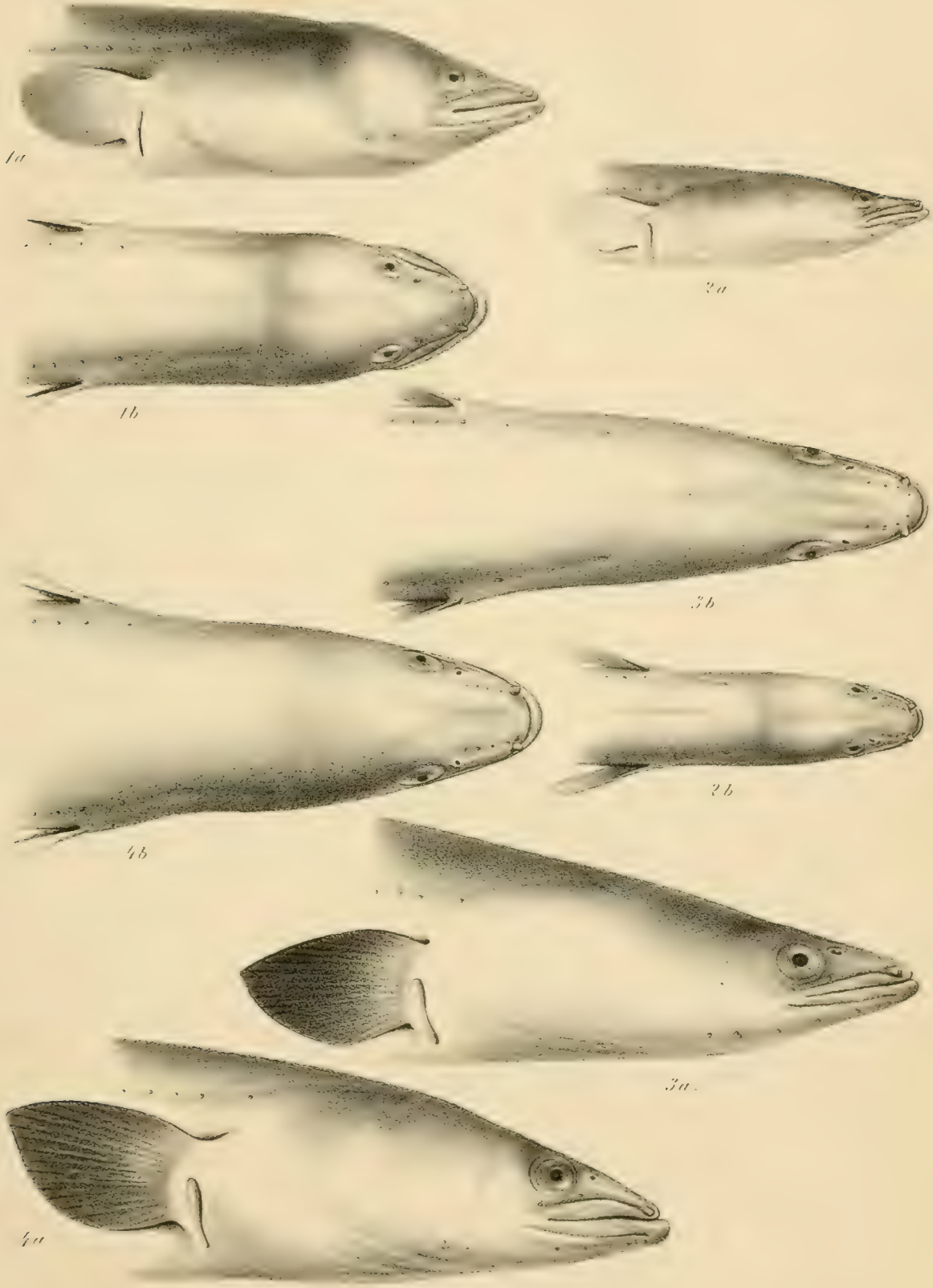
— - 8. Sketch of a 31 silver eel with large interorbital space ♀ in c. $^1/_3$ lin. size*).

- 9. 24 — - - small — — ♀ - - $^1/_2$ - -

10. - 19^1 . yellow - - large — — ♀ - - $^1/_2$ -

The figures are drawn by means of the *Camera lucida* from eels that have for some time been kept in spirit.

*) Note: The tip of the caudal fin of this eel was a little damaged, but is drawn like that of a normal eel.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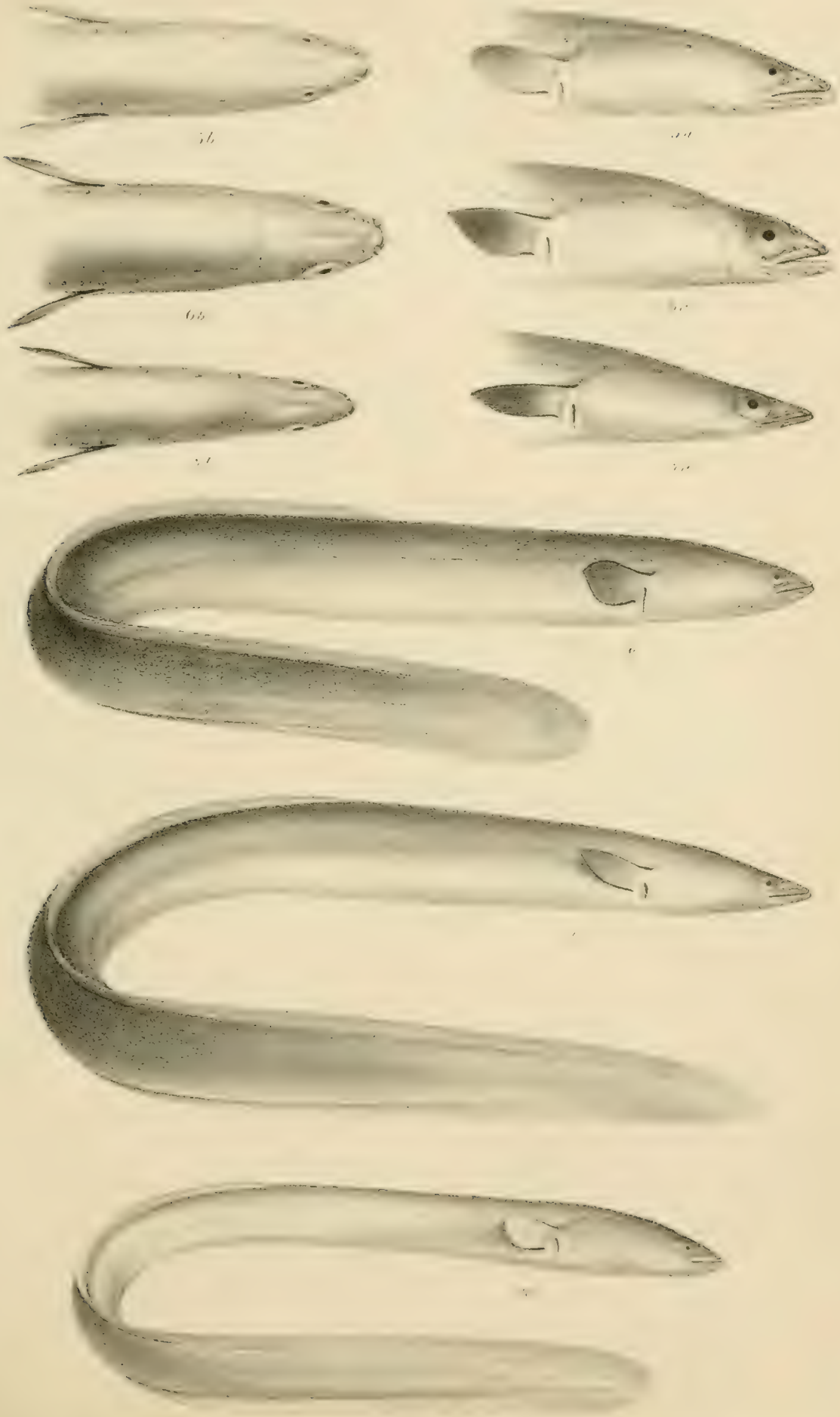

II. Om de ved Stege og nærliggende indenskærs Farvande levende Fiskearter med Bemærkninger om deres Forekomst, Legetid o. s. v.

Af **C. G. Joh. Petersen.**

Aborren *(Perca fluviatilis)* har tidligere været langt almindeligere end nu. Den leger her i Farvandene, men i 1894 saa jeg det ikke.

Ulken *(Cottus scorpius)*. Enkelte Individer, men kun voksne; efter Fiskernes Sigende er der langt fra lige mange hvert Aar, som det andre Steder plejer at være Tilfældet. Iaar er der kun faa.

Kutlinger *(Gobius niger)* meget almindelig. Den legede ved Stege midt i Maj 94.

Gobius sp.

Stenbideren *(Cyclopterus lumpus)* saas af og til.

Aalekvabben *(Zoarces viviparus)*. Mange Aalekvabber saas, men megen Forskel paa de forskellige Aar, sige Fiskerne.

Hundestejlen *(Gasterosteus aculeatus* og *pungitius)*. Begge Arter ere særdeles almindelige. *G. aculeatus* legede midt i Maj.

Tangsnarren *(Spinachia vulgaris)*. Ikke hyppig. Leger her næppe.

Hornfisk *(Belone vulgaris)*. I Efteraaret 93 fangedes i Bundgarn i Stege Nor en Mængde Hornfiskeunger paa c. 9″ Længde.

Torsken *(Gadus callarias)* fandtes ikke ved Stege i 93—94, til andre Aar kan den efter Sigende være almindelig der. Geddeperioder og Torskeperioder siges at afløse hinanden i disse Farvande. Ved Masnedsund og særlig vestefter optræder Torsken til Stadighed, og her ere Gedderne kun sjældne. Torsken yngler næppe nogensinde i disse Farvande, dertil er bl. a. Saltholdigheden for ringe.

Tobisen *(Ammodytes)*.

Pighvarren *(Rhombus maximus)*. Et enkelt mindre Individ saas.

Skrubben *(Pleuronectes flesus)* findes her til Stadighed, men ikke i stor Mængde; den yngler næppe nogensinde her, og yngre Individer saas aldeles ikke. I Begyndelsen af Maj saas enkelte Skrubber med megen Rogn.

Rødspætten *(Pleuronectes platessa)* er endnu sjældnere end Skrubben og leger her sikkert ikke.

Naalefisken *(Syngnathus typhle)* hyppig, og leger her som andet Steds, hvor den findes.

Orreden *(Salmo trutta)* almindelig. Den udklækkes kunstig flere Steder i Bækkene.

Silden *(Clupea harengus)* fiskes meget i Bundgarn, saavel Foraar som Efteraar. I de første Dage af April iagttoges Mængder af nylig udklækket Sildeyngel i Dammene ombord. De forsvandt snart igen. Det maa antages, at Silden leger i Nærheden, hvilket ogsaa de i Bundgarnene fangede Silds Kønsorganer kunde tyde paa, men det lykkedes mig ikke at paavise Legepladserne.

Aalen *(Anguilla vulgaris)* findes overalt og i stort Antal, men de ere temmelig smaa. Hanaal ere rigelig repræsenterede.

Aalene fiskes mest med Vaad og ved Blus med Piglyster. Savlysteren indførtes i Kallehave af Biologisk Station, dog bruge de der en egen selvlavet Form. Aalekroge og Aaleruser bruges kun lidt.

Rudskallen *(Leuciscus erythropthalmus)* er ret almindelig her. Om dens Legen iagttoges intet.

2, der fangedes i Stege Nor i Oktober 93, havde Maverne fyldte med en grønsort Masse, hvis Hovedbestanddel var Dipterlarver.

Løjeren *(Leuciscus alburnus)* var særdeles almindelig i Strømmen i Stege Havn.

Emden *(Leuciscus idus)*. Enkelte Individer fangedes.

Brasenen *(Abramis brama)*. Yngre Individer fangedes af og til enkeltvis.

Gedden *(Esox lucius)* er hyppig i disse Vande, og der drives betydeligt Fiskeri efter den.

Den legede i 1894 fra c. 20de April i Stege Nor og ved Staureby. (Ogsaa i Præstø Fjord fandtes dens Rogn paa Havbunden.)

De levende, enkeltvis spredte Æg fandtes kun, hvor Bundens Algetæppe var tæt nok til at forhindre Ægene fra at synke ned i Mudderet, men ikke hvor der var ren Sandbund, *Characeer* eller *Zostera;* de fandtes f. Eks. i de Alger, der vare fulgte med op i et Aalevaad, som Fiskerne fiskede Aal med. Ægene fandtes kun paa Dybder af c. 6—10 Fod. Paa den største Legeplads (ved Staureby i Sandvig) stod mange Gedderuser, og her foregik et stort Fiskeri af legende og udlegede Gedder.

Gedder fanges desuden i store Vaad, saakaldte Strandgarn, et Slags Landdragningsvaad, samt i »Tog«, d. v. s. et Drivvaad med store Masker, der ligner Aaledrivvaad og bruges paa samme Maade.

Med Stangeredskaber fanges desuden en Del Gedder paa Blus, og endelig tages en Del paa Blink.

I Vinteren 1894 dode en Mængde Gedder (ogsaa Aborrer og enkelte andre Ferskvandsfisk) under de stærke Storme i Midten af Februar Maaned saavel i Stege Nor som i Præsto Fjord og i Bogestrømmen ned mod Masnedsund. Vandet blev meget plumret af Stormen, og Saltholdigheden steg til næsten $1^1/_2$ % ved Stege, endelig indtraadte ogsaa stræng Kulde i denne Tid eller umiddelbart derpaa. Gedderne dode saavel i de udsatte Ruser og i det frie, som i Hyttefade. Fiskerne vide at fortælle om mange lignende tidligere Lejligheder med »Bundfrost«, der dræber Gedderne i Masse. I Aaret 1894 var Geddefiskeriet ifølge Statistiken ikke desto mindre det bedste, det i flere Aar har været.

Ved Forsøg ombord viste det sig, at en Gedde meget vel kunde leve i Vand af $1^1/_2$ % Saltholdighed, hvori der var udrørt en Mængde Mudder, jeg maa derfor tro, at det enten er Kulden, der dræbe Gedderne, eller maaske alle tre Ting i Forening, eller, hvad der vel er det sandsynligste, kun de svageste Individer bukke under for Stormens uheldige Indvirkninger.

Om Faunaen i Stege Nor skal her, for at give en Forestilling om dens Karakter af Brakvands-Fauna, nævnes, at Pighude ganske savnes.

Af Orme saas bl. a. en *Nereide*.

Af Krebsdyr: *Idothea*, *Sphæroma*, *Gammarus*, *Corophium* o. s. v.

I alt 1 eller to Individer af *Carcinus mænas*.

Palæmon Fabricii (den alm. Reje) er derimod almindelig, men Fiskeriet efter den er taget overordentlig af.

Af *Mysider* fandtes flere Arter, bl. a. *Mysis flexuosa* og *Macropsis Slabberi*.

Insekter: Flere Slags, f. Eks. *Notonecta*, og navnlig Larver vare meget almindelige.

Bryozoer: En *Membranipora*.

Bløddyr: *Cardium edule* alm., *Card. exiguum* alm., *Macoma baltica*, *Mya arenaria*, *Hydrobia sp.*, *Littorina tenebrosa*, *Neritina fluviatilis*, og et Par Arter *Limnæus* var alt.

Det pelagiske Dyreliv var reduceret til et Minimum af Arter, nogle faa *Mysider* og *Aurelia aurita*, af Smaakrebs saa jeg lidet i den Tid, jeg laa der.

I Stege Nor var Bunden dækket paa store Strækninger af *Characeer* og forskellige *Potamageton*-Arter; Bændeltang forekom dog ogsaa.

Det skal udtrykkelig omtales, at det med ovenstaaende ikke er Hensigten at give en Fortegnelse over alle de Fiskearter, der kunne forekomme ved Stege og nærmeste Omegn; men kun at give et Billede af den der levende Fiskebestand og dermed vise dens ejendommelige Karakter af halv Salt- halv Ferskvandsfauna, af hvis Arter kun faa lege paa Stedet, medens Resten kun strejfer derind paa mere eller mindre regelmæssige Vandringer.

III. Om de ved Frederikssund i Roskildefjord 1894 iagttagne Fiskearter med Bemærkninger o. s. v.

Af **C. G. Joh. Petersen**.

Sokarudsen *(Ctenolabrus rupestris)*. To Individer saas.

Ulken *(Cottus scorpius)* almindelig, men kun som voksen.

Kutlingerne. *Gobius niger* legede i Mængde i Begyndelsen af Juni Maaned. Den fiskes i et Antal af flere Tusinde daglig, saalænge Aalekrogfiskeriet staar paa.

Gobius microps legede i Juni. Almindelig.

Aalekvabben *(Zoarces viviparus)* meget almindelig.

Tangsnarren *(Spinachia vulgaris)*. Ret hyppig, men legede først ude ved Lynæs.

Hundestejlerne *(Gasterosteus aculeatus* og *pungitius)*. Begge almindelige. De legede begge i Slutningen af Maj.

Hornfisken *(Belone vulgaris)*. Smaa Unger saas i Mængde allerede i Juni Maaned, i Slutningen af September, før de forlode Fjorden, vare de $7^1/_2$—$9^1/_2$″ lange. Legepladserne ere vistnok i den store Issefjordsbredning, hvor ogsaa Hovedfiskeriet foregaar.

Torsken *(Gadus callarias)* var meget sjælden. Et Individ fangedes 22. September i en Ruse.

Skrubben *(Pleuronectes flesus)* er meget almindelig, men leger her ikke. Individer under $3^1/_2$″ fandtes ikke. Der drives et ikke ganske ubetydeligt Fiskeri efter den. Den synes som voxen at vandre regelmæssig ud og ind ad Fjorden.

Isingen *(Pleuronectes limanda)*. Kun et Individ saas.

Tungen *(Solea vulgaris)*. Et Individ saas.

Naalefisken *(Syngnathus typhle)* almindelig og legede som sædvanlig.

Ørreden *(Salmo trutta)* hyppig. Leger i mange af Aaerne. Der drives om Efteraaret Rusefiskeri efter den.

Smelten *(Osmerus eperlanus)* fanges ret ofte, men enkeltvis i Sildegarn om Efteraaret.

Silden *(Clupea harengus)* fandtes der hele Tiden, men hyppigst Foraar og Efteraar, til hvilke Tider der drives Fiskeri efter den. Den leger dog næppe i selve Roskildefjord, men flere Aargange vare til Stede.

Brislingen *(Clupea sprattus)*, enkelte fangedes.

Brasenen *(Abramis brama)*. Et Par Individer fangedes.

Karudsen *(Cyprinus carassius)*. Et enkelt Individ fangedes 22de Juni, vel sagtens nylig udvandret fra et eller andet Ferskvand.

Gedden *(Esox lucius)*. Et Individ fangedes i Efteraaret.

Aalen *(Anguilla vulgaris)* er saa at sige den eneste Fiskeart, der drives et videre indbringende Fiskeri efter. Da dens Biologi andet Steds vil blive omtalt, skal jeg ikke her gaa nærmere ind paa Sagen.

Roskildefjorden er ved sin Munding ved Lynæs et udpræget Saltvand, og ved Roskilde et næsten rent Ferskvand, alle Overgange findes mellem disse to Yderpunkter. Pighude findes saaledes ikke ved Roskilde, men endnu ved Frederikssund lever *Asterias rubens*. Forskellige andre Saltvandsdyr, saasom *Cardium edule* og *Mytilus edulis* leve helt op til Roskilde.

IV. Togt med „Havørnen“ fra Issefjorden til Limfjorden og det nordlige Kattegat. 2.—13. Oktober 1894.

Af **C. G. Joh. Petersen.**

2den Oktober ankom »Havørnen« Kl. 9 Fm. forsinket af Taage til Frederikssund. Kl. $10^1/_4$ Fm. afsejlet igen.

Nr. 1. Hesseloen i ONO. 7 Kvartmils Afstand. 12 Favne Vand. Aalehaandvaad: 4 Isinger, 2 Ulke, *Actinier*, 1 *Echinus Drøbakiensis*. Vaaddet hoppede over større Sten.

Til Grenaa Aften Kl. $6^1/_2$.

3die Oktober fra Grenaa Kl. 6 Morgen.

Nr. 2. Rejehov ved Limfjordsbroen gav ingen Flynderyngel. Det grønne smaamaskede Snurrevaad:

4 Skrubber paa 6, 6, $6^1/_2$ og $5^1/_2$ Tommes Længde.
2 Rødspætter paa $4^3/_4$ og $4^3/_4$″.
Crangon i Masse.

Nr. 3. Syd for Egholm paa Sandet. Det grønne Vaad. 2 Træk.

3 Skrubber paa $3^3/_4$, $4^3/_4$, $4^1/_4$″.
1 Pighvar paa 3″.
Crangon i Masse.

Nr. 4. Troldholmene. Grønne Vaad paa Sandet ved Vadning.

4 Skrubber: $4^3/_4$, $4^1/_4$, $4^1/_4$, $4^1/_4$″.
1 Pighvar: $2^3/_4$″.
1 lille Osters paa *Buccinum*.
Buccinum i Masse etc.

Nr. 5. Samme Sted. Om Aftenen med Aalehaandvaad paa Kanten af Renden. 7 Træk.

2 mislykkedes fordi Ankeret ikke holdt.
12 Skrubber $10^1{}_4$, $9^1{}_2$, $11^1{}_2$, 10, 7, 10, $8^1{}_2$, $9^1{}_2$, 7, $8^1{}_2$, 7, $6^1{}_2$″.
1 Rødspætte $7^1/_2$″.

17 Torsk 17, 18½, 14, 13½, 16¾, 9½, 12, 11¼, 9¼, 11½, 9¼, 10, 9½, 9¼, 9½, 10½, 9″.

1 *Motella cimbria.*

36 Aal. 18 smaa, 18 store, vejede tilsammen 10 ℔.

4de Oktober.

Nr. 6. I Trend-Aa nær Ærtebolle.

Masser af Smaaskrubber fra iaar og en enkelt ældre: 7¼, 4¼, 3½, 3½, 3¼, 3¼, 3, 3, 2¾, 2¾, 2¾ og flere Hundrede mellem 2½ og 1¼″.

Udenfor paa Revlen kun en ganske enkelt Skrubbe.

Nr. 7. I Fuur Sund. Søgt 2 Steder paa Revlerne med grønt Vaad og Rejehov.

4 Skrubber 7½, 6¾, 6½, 3½″.

1 Pighvar 5″.

Nr. 8. Flere Træk Ost for Nykjøbing paa 5—6 Fv. Vand. Grønt Vaad.

c. 20 større Rødspætter.

Nogle Isinger.

1 Aal.

Ophiurer i Masse.

Bunden graat, friskt Leer.

Nr. 9. Glyngøre-Hage paa Revlerne. Grønt Vaad.

Rødspætter 6¼, 5¾, 5¾, 5½, 5½, 3½, 3, 2¾″.

5te Oktober.

Nr. 10. Venø Bugt ved Vrald Odde. Flere Træk med grønt Vaad.

5 Rødspætter 10¼, 7¼, 7, 6½, 6″.

1 Slethvar 6½″.

Nr. 11. Ved Handbjerg paa Revlerne og ude ved Kanten ialt 3 Træk med grønt Vaad.

9 Skrubber 6¼, 6, 5¾, 5¾, 5½, 5½, 5, 4¾, 4½″.

Ingen Rødspætter.

6te Oktober.

Nr. 12. Ved den nye Aggerkanal. Flere Træk med grønt Vaad.

8 Skrubber 9¼, 6¾, 6¾, 6½, 6½, 6, 5½, 5½″.

4 Pighvar 7, 3¼, 1¾, 1½″.

1 Slethvar 3¼″.

90 Rødspætter 8½, 8, 8, 7¾, 7¼, 7, 6½, 6½, 6½, 6, 5¾, 5¾, 5¾, 5¾, 5½, 5½, 5, 4¾, 4½, 4½, 4¼, 4¼, 4¼, 4¼, 4, 4, 3¾, 3¾, 3¾, 3¾, 3¾, 3¾, 3, 3½, 3½, 3½, 3½, 3, 3, 3, 3, 2¾, 2¾, 2¾, 2½, 2½, 2½, 2¼, 2, 2, 2, 2, 2, 2, 2, 27 paa 1¾ og 6 paa 1½″.

Nr. 13. Indenfor Fjordgrunden paa 2 Fv. Vand. Grønt Vaad.

Rødspætter $11^1/_4$, $9^1/_4$, $6^3/_4$, $6^1/_2$, $6^1/_4$, $6^1/_4$, 6, 6, $5^3/_4$, $5^1/_2$, $5^1/_2$, $5^1/_4$, 5, 5, $4^3/_4$, $4^3/_4$, $4^3/_4$, $4^3/_4$, $4^3/_4$, $4^3/_4$, $4^3/_4$, $4^1/_2$, $4^1/_2$, $4^1/_2$, $4^1/_2$, $4^1/_2$, $4^1/_2$, $4^1/_2$, $4^1/_2$, $4^1/_2$, $4^1/_2$, $4^1/_2$, $4^1/_2$, 8 paa $4^1/_4$, 4 paa 4. $3^3/_4$, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 17 paa $2^3/_4$, 10 paa $2^1/_2$, 4 paa $2^1/_4$".

Isinger $9^1/_4$, $7^3/_4$, $4^3/_4$, $4^1/_2$, $4^1/_4$, $4^1/_8$, 4, $3^3/_4$, $3^3/_4$, $3^3/_4$, $3^1/_2$, $3^1/_2$, $2^1/_2$, $2^1/_4$, $2^1/_4$, 7 paa 2 og 3 paa $1^3/_4$".

1 Hvilling (Séé) $4^1/_2$".

Nr. 14. Længere inde paa Fjordgrunden. Grønt Vaad.

Paa 7 Fod Vand c. 140 Fladfisk.

Paa 3 Fod Vand c. 40—50 Fladfisk.

1 lille Knurhane.

1 Sild.

Tobiser.

2 Slethvarrer $4^1/_4$, $3^1/_4$".

Rødspætter 8, $7^1/_4$, $6^3/_4$, $6^3/_4$, $6^1/_2$, $6^1/_4$, $6^1/_4$, 6, 6, 6, 6, $5^3/_4$, $5^3/_4$, $5^1/_2$, $5^1/_2$, 5, 5, $4^1/_2$, $4^1/_4$ $4^1/_4$, $4^1/_4$, $4^1/_4$, $4^1/_4$, 4, 4, $3^3/_4$, $3^3/_4$, 3, 3, 4 paa $2^3/_4$, 21 paa $2^1/_2$, 40 paa $2^1/_4$, 43 paa 2, $1^3/_4$".

Isinger $4^1/_2$, 2, 2, 2, 2, 2, 2, 2, 2, 26 paa $1^3/_4$, 9 paa $1^1/_2$, 2 paa $1^1/_4$".

Nr. 15. Ost for Jegindø-Tap paa 8 Fv. Vand. 3 Træk. Grønt Vaad.

Rodspætter 10, 10, 10, 6 paa $9^3/_4$, 7 paa $9^1/_2$, $9^1/_4$, $9^1/_4$, 6 paa 9, $8^3/_4$, 4 paa $8^1/_2$, $8^1/_4$, 5 paa 8, $7^3/_4$, $7^3/_4$, $7^3/_4$, 5 paa $7^1/_2$, $7^1/_4$, 7, $6^3/_4$, $6^1/_2$, $6^1/_2$, $6^1/_2$, $5^1/_4$, 5, $4^3/_4$, $4^1/_2$, $3^3/_4$, $2^3/_4$, $2^1/_2$, $2^1/_2$, $2^1/_2$, $2^1/_4$, 2".

Isinger 8, 8, $7^1/_2$, $7^1/_4$, $5^1/_2$, $5^1/_4$, 5, 5, $4^1/_2$ 4, 3, $1^1/_4$".

7de Oktober: Søndag.

8de Oktober.

Nr. 16. Skarre-Odde i Thisted Bredning. Smukt hvidt Sand, men Vadning saavel som Vaaddræt paa dybere Sandbund gav aldeles ingen Fladfisk.

Nr. 17. Saa i Thisted hos Fiskerne store Rodspætter, fiskede i Bredningen, en enkelt til $^1/_2$ ℔ fiskes af og til, alle andre ere større. Men Bredningen saavel ved Feggesund som mod Vest skulde være lukket af Brændetang, saa at saavel Indvandring af smaa, som Udvandring af store Rødspætter er umulig?

9de Oktober.

Nr. 18. Ved Indløbet til Agger-Dyb (Logstør) fisket med grønt Vaad paa dyb, ren Sandbund ialt kun:

1 større Skrubbe.

Nr. 19. Længere inde ved Logstor. Flere Træk med grønt Vaad.
1 Pighvar 4″.
1 større Skrubbe.

10de Oktober.

Nr. 20. Ved Hals (Kattegat). Paa Grundene ved Vadning og forskellig Bund samt Træk paa 1—2 Fv. Vand.
Skrubber $7^3/_4$, $6^3/_4$, $6^1/_2$, $6^1/_2$, $5^3/_4$, $5^3/_4$, $5^3/_4$, $5^1/_2$, $5^1/_4$, $5^1/_4$, $4^3/_4$, $4^1/_4$, 4, $2^3/_4$, $2^3/_4$″.
Rødspætter 8, $6^1/_2$, $5^1/_2$, $5^1/_4$, $4^1/_2$, $4^1/_2$, $4^1/_4$, $4^1/_4$, 4, $2^3/_4$, $2^3/_4$″.
Isinger $10^1/_4$, 8″.
1 Tunge 2″.
Aarets Yngel af Rødspætter saaledes kun meget sparsomt repræsenteret.

11te Oktober.

Nr. 21. Mellem Sæby og Bangsbo paa Revlerne samt paa 2 Fv. Vand. Grønt Vaad. Flere Træk.
Sildeyngel, nogle ganske nogne, andre en Del større, de største 4—5 Tommer.
Tobiser.
Naalefisk.
Gobius minutus.
3 Pighvar $3^1/_2$, $3^1/_4$, 3″.
Skrubber $8^1/_2$, $8^1/_4$, 8, $7^1/_2$, $6^3/_4$, 6, 6, $5^1/_2$, $5^1/_4$, $4^1/_4$, $4^1/_4$, 4″.
Rødspætter 8, $7^1/_2$, 7, 7, 7, 7, $6^3/_4$, $6^3/_4$, $6^3/_4$, $6^1/_2$, $6^1/_2$, $6^1/_2$, $6^1/_2$, $6^1/_4$, $6^1/_4$, $6^1/_4$, $6^1/_4$, 6, 6, $5^3/_4$, $5^1/_2$, $5^1/_4$, $5^1/_4$, $5^1/_4$, $4^1/_4$, $4^1/_4$, $3^3/_4$ $3^3/_4$, $3^1/_2$, $3^1/_2$, $3^1/_2$, $3^1/_4$, $3^1/_4$, $3^1/_4$, 3, 3, 3, $2^1/_2$″.
Isinger 11, $9^1/_2$, 9, $8^1/_2$, $7^1/_2$, $7^1/_4$, 7, 5, 5, $4^3/_4$, $4^1/_2$, $4^1/_2$, $4^1/_2$, 4, $2^1/_2$, $2^1/_2$″.

Nr. 22. Udenfor Frederikshavns Havn paa c. 3 Fod Vand. 2 Træk. Grønt Vaad.
Skrubber $10^1/_2$, $10^1/_4$, $9^1/_2$, $9^1/_4$, 9, $8^3/_4$, $8^1/_2$, $8^1/_2$, $8^1/_4$, 8, 8, 8, $7^3/_4$, $7^3/_4$, $7^3/_4$, $7^1/_2$, $7^1/_2$, $7^1/_2$ $7^1/_4$, 7, 7, 7, 7, 7, $6^3/_4$, $6^3/_4$, $6^1/_4$, 6, 6, 6, 6, $5^3/_4$, $5^3/_4$, $5^3/_4$, $5^1/_2$, $5^1/_2$, $5^1/_2$, $5^1/_2$, $5^1/_2$, $5^1/_4$, $5^1/_4$, $5^1/_4$, 5, 5, $4^1/_2$, $4^1/_2$, $4^1/_4$, $4^1/_4$″.
Rødspætter 10, 9, 9, $8^1/_2$, $8^1/_4$, 8, $7^3/_4$, $7^1/_2$, $7^1/_2$, $7^1/_4$, 7, 7, 7, $6^3/_4$, $6^3/_4$, $6^3/_4$, $6^3/_4$, 11 paa $6^1/_2$, 12 paa $6^1/_4$, 13 paa 6, 9 paa $5^3/_4$, 9 paa $5^1/_2$, 4 paa $5^1/_4$, $4^1/_2$, $4^1/_4$, 4, $3^3/_4$, $3^3/_4$, 5 paa $3^1/_2$, 11 paa $3^1/_4$, 3, 3, 3, $2^3/_4$, $2^1/_2$, $2^1/_4$″.
Isinger 8, 8, $7^3/_4$, 7, $6^1/_2$, $6^1/_2$, $6^1/_2$, $6^1/_4$, 6″.
1 Slethvar $4^1/_4$″.

12te Oktober afrejst fra Frederikshavn.
13de Oktober i Frederikssund.

Aarets Yngel af Rødspætter repræsenteres paa denne Tid af Aaret ved Individerne under 3—3½". Som det vil ses, vare disse talrig til Stede ved Aggerkanalen og paa Fjordgrunden indenfor samme; mellem Aalborg og Mors fandtes aldeles ingen, ejheller i Thisted Bredning; ved Glyngore i Salling-Sund fandtes 3, ved Jegindø-Tap 6. Ved Udløbet til Kattegat ved Hals fandtes kun 2 Individer af Aarets Yngel, ved Sæby derimod 10 og ved Frederikshavn en Mængde.

Rødspættens Yngel synes saaledes at indvandre til Limfjorden vestfra, hvad ogsaa tidligere er antaget. (Se Beretning IV. Biolog. Station.)

Skrubbens Yngel fra iaar fandtes derimod i Mængde ved Trend Aa; den maa antages repræsenteret ved Individer under c. 3"; saadanne fandtes ellers ikke ved Limfjordens Kyster i Saltvand (se dog Hals).

V. Om Mærkning af levende Rødspætter.

Af **C. G. Joh. Petersen.**

396 mærkede Rødspætter udsattes i Mariagerfjord ved Mariager 19. April 1894.

Følgende ere indfangede:

Nr.	Længde i Tom.	Fanget hvor.	Dato 1894.	Længde i Tom.	Maalt af hvem.
831.	$8^3/_4$.	Mariagerfjord.	11. August.	$8^3/_4$.	C. G. Joh. Petersen.
932.	10.	—	12. —	10.	—
991.	$10^1/_4$.	—	27. —	$10^1/_4$.	
723.	$9^1/_2$.	Kattegat (Carl Bang).	28. Septbr.	$11^1/_4$.	
?	?	Nordl. Kattegat (Brønnum).	Oktober.	?	Vejede $^6/_{10}$ ü. Brønnum.
815.	$9^1/_2$.	Aalborgbugten (P. Schou).	—	$11^1/_4$.	C. G. Joh. Petersen.
869.	10.	Mariagerfjord.	—	$10^1/_2$.	
810.	$9^1/_2$.	—	—	$11^1/_4$.	—
866.	$9^1/_4$.	—	—	10.	—
			1895.		
1000.	9.	—	Januar.	$10^1/_2$.	—
945.	$9^1/_4$.	—	—	$10^1/_2$.	—
744.	$9^1/_2$.	—	—	$10^3/_4$.	
878.	$9^3/_4$.	—	Marts.	$10^1/_4$.	—
779.	$9^1/_2$.			10	

298 mærkede Rødspætter udsattes i Thisted Bredning d. 28. 29. Marts 1894.

Følgende ere indfangede:

Nr.	Længde i Tom.	Fanget hvor.	Dato 1894.	Længde i Tom.	Maalt af hvem.
408.	9.	Vilsund.	27. Juni.	11.	Agent Tachou.
592.	9.	—	28. —	12¼.	-
617.	9.	—	26. —	11¼.	—
507.	8¾.	Thisted Bredning.	27. —	10¾.	
541.	9.	Kirkegaards Hage.	22. —	11½.	—
686.	9.	Thisted Bredning.	29. —	12.	—
496.	9 ? 9¼.	—	29. —	12.	—
630.	9½.	—	29. —	12.	–
681.	9¼.	Vilsund.	29. —	12.	—
649.	9.	Gudnæs Hage.	28. —	11¼.	—
661.	9.	Vilsund.	29. —	12¼.	—
433.	9.	Ost for Vilsund.	2. Juli.	12.	
497.	9 ? 9¼.	—	2. —	11.	—
502.	9.	Thisted Bredning.	3. —	12.	
585.	9½.	—	3. —	12.	—
690.	9.	—	2. —	12.	—
620.	10.	—	2. —	13.	—
456.	9.	—	2. —	11¼.	
607.	9¼.	—	5. —	12.	—
687.	9.	Aas Bakker.	5. —	11¾.	—
697.	10.	Thisted Bredning.	7. —	13¼.	—
672.	9¼.	—	7. —	12.	—
569.	9.	—	7. —	13.	—
448.	9.	—	7. —	11¼.	—
572.	9½.	Vilsund.	9. —	12¼.	—

Nr.	Længde i Tom.	Fanget hvor.	Dato 1894.	Længde i Tom.	Maalt af hvem.	
517.	$9^{1}/_{2}$.	Thisted Bredning.	10. Juli.	$12^{1}/_{4}$.	Agent Tachou.	
478.	$8^{3}/_{4}$.	—	12. —	11.	—	
509.	$9^{1}/_{4}$.	—	12. —	$12^{1}/_{2}$.	—	
505.	9.	—	11. —	12.	—	
528.	$9^{1}/_{4}$.	—	17. —	$12^{1}/_{4}$.		
631.	$9^{1}/_{2}$.	—	19. —	$12^{3}/_{4}$.	—	
659.	$9^{1}/_{4}$.	—	18. —	$12^{1}/_{2}$.	—	
590.	$8^{3}/_{4}$.	Øst for Vilsund.	16. —	12.		
511.	$8^{1}/_{4}$.	Thisted Bredning.	16. —	$11^{1}/_{8}$.	—	
513.	$8^{1}/_{2}$.	—	16. —	12.	—	
551.	$9^{1}/_{2}$.	—	16. —	$12^{3}/_{4}$.	—	
534.	$8^{3}/_{4}$.	—	16. —	12.	—	
431.	$8^{3}/_{4}$.	—	22. —	$13^{1}/_{4}$.	—	
667.	$9^{1}/_{2}$.	Øst for Vilsund.	21. —	13.	—	
489.	9.	Thisted Bredning.	20. —	$12^{1}/_{4}$.	—	Uden Hoved.
435.	$8^{1}/_{2}$.	Dragsbæk Bugt.	21. —	11.	—	
658.	$9^{1}/_{2}$.	Silstrup Hoved.	21. —	$12^{1}/_{2}$.	—	
493.	$9^{1}/_{4}$.	Silstrup.	21. —	$12^{1}/_{2}$.	—	
437.	$9^{1}/_{2}$.	Thisted Bredning.	23. —	$11^{3}/_{4}$.	—	
492.	9.	—	25. —	$11^{1}/_{8}$.	—	
512.	$9^{1}/_{4}$.	—	24. —	13.	—	
506.	9.	—	23. —	12.	—	
547.	$8^{1}/_{2}$.	—	23. —	$11^{1}/_{2}$.	—	
488.	$9^{1}/_{4}$.	—	25. —	12.	—	
481.	$9^{3}/_{4}$.	—	27. —	$13^{3}/_{4}$.	—	
416.	$9^{1}/_{4}$.	—	27. —	$12^{3}/_{4}$.	—	
539.	$9^{1}/_{4}$.	—	29. —	$11^{3}/_{4}$.	—	

Nr	Længde i Tom.	Fanget hvor.	Dato 1894.	Længde i Tom.	Maalt af hvem.
587.	9¼.	Thisted Bredning.	30. Juli	11.	Agent Tachou.
500.	8¼		30	11¼.	
451?	9¼?	Malle Hage.	30.	13¼	
665.	9½.	Thisted Bredning.	6. August.	12¼.	
412.	9.		2	12¼.	
404.	9.		3	12¼	
508.	8¼		5.	12¼.	
419.	8¼.		2. -	12¼.	
586.	8¼.				
651.	9¼.				
653.	9.		August.		Uden Oplysninger.
639	10				
664.	9				
559	9.	Livo Bredning.	21. August.	12½.	Tranum.
113.	8½.	Thisted Bredning.	23. Septbr.	13.	—
453.	9.		Oktober.	13.	Petersen.
?				13.	— Mærkerne vare voksede udaf Fiskene.
?				13.	—
?				12.	-
603.	9¼				
626.	9¼.				
614.	10.	? Thisted.	?	?	Ingen. Kun Mærkerne indsendte.
622.	9.				
621.	9¼				
700.	8¼.				

Foranstaaende Rodspætter vare mærkede med to Benknapper med et indbrændt Nr., fastholdte af en Sølvtraad, der gaar tvers igennem Fisken mellem Rygfinnens Straalebærere, ligesom de i Beretning IV, pg. 140 omtalte.

Det vil ses, at Fiskene gennemsnitlig ere voksede mere og hurtigere i Limfjorden end i Mariagerfjord, dog skal det her bemærkes, at de i Limfjorden fangede ere maalte i levende Tilstand og ere derfor maalte forholdsvis længere end de fra Mariager, hvilke jeg selv har maalt i indtørret Tilstand. Om man nu ogsaa vil regne Fiskens Indskrumpning til en god Tomme, saa ere dog Limfjordsfiskene alligevel nok saa store, som de fra Mariager; dette maa selvfølgelig hidrøre fra Naturforholdenes Forskelligheder; thi Fiskene ere alle tagne i Vesterhavet, saavidt vides paa omtrent de samme Steder.

Det vil endvidere ses, at medens af de i Thisted Bredning udsatte Fisk ingen er indfanget uden i selve Limfjorden og næsten alle i Thisteds umiddelbare Nærhed, ere 3 udvandrede fra Mariagerfjord til Kattegat; af den ene af disse har jeg dog ikke set Mærket selv*). Ingen af de ogsaa i tidligere Aar i Limfjorden udsatte Fisk ere genfangede med Mærker paa udenfor Fjorden. Dette kan dog ikke betragtes som Bevis paa, at de ikke vandre ud af denne Fjord, men maaske snarere paa, at Mærkerne kun blive siddende i nogle Maaneder, for de falde, rives eller vokse ud af Fisken; Fisk med Ar efter Mærket har jeg flere Gange set. Paa den anden Side sidde de Mærker, som tilsendtes mig fra Mariager i Marts 1895, altsaa efter omtrent et Aars Forløb, ligesaa fast, som da de blev udsatte. Mærkværdig er det, at jeg siden August 1894 modtog saa faa mærkede Fisk, og at jeg iaar aldeles ingen modtog af de i 1893 udsatte; — skulde det være muligt, at omtrent alle de mærkede Fisk blive opfiskede i Sommerens Løb, uden at Fiskerne enten se eller aflevere de paasiddende Mærker? Forhaabentlig ville videre Undersøgelser kunne oplyse dette.

*) En fjerde er senere kommen til: Nr. 830; den modtoges 4de Maj 1895. Den maalte 11" og var fanget udenfor Frederikshavns Havn.

VI. Fortsatte Undersøgelser over Rødspætteyngelens Forekomst i Østersøen i 1894 og 95.

Af **Th. Mortensen,** Cand. mag.

(Undersøgelserne ere udførte paa Foranledning af og under Ledelse af Forstanderen for Biologisk Station, for at supplere de fra denne i de sidste Aar gjorte Undersøgelser over Flynderfiskenes Biologi.)

Det var ved de fra Biologisk Station anstillede Undersøgelser konstateret, at der i 1893 næsten ingen Rødspætteunger af Aarets Yngel (0-Gruppen) fandtes ved de danske Østersøkyster. Kun 3 vare fiskede ved Snogebæk paa Bornholm, den 8de September, henholdsvis 2, $2^1/_2$ og $2^3/_4$″ lange, og 1 ved Hesnæs paa Falster, den 9de August, der maalte 2″. Paa Grund af denne næsten absolute Mangel paa Rødspætteyngel i Østersøen mente Dr. Petersen at maatte antage, at de mange større Rødspætter, der findes i Østersøen, ere indvandrede fra Kattegat. Hans Anskuelser, der findes udtalte paa forskellige Steder i IV. Beretning fra den danske biologiske Station, ere i Korthed følgende:

Rødspættens Æg have ved c. 10° C. en Vægtfylde af omtrent $1{,}_{012}$—$1{,}_{015}$ og fordre saaledes for at kunne flyde eller svæve i Vandet, at dette maa have en Vægtfylde, der ikke er ringere, altsaa en Saltholdighed af c. $1{,}_{11}$ %. Da en saa stor Saltholdighed kun undtagelsesvis findes i Østersøen, maa Rødspætteæggene altsaa synke til Bunds der, og som Følge deraf udvikles der ingen Unger af dem. Østersøens talrige Rødspættebestand »maa derfor fødes andet Steds og senere indvandre til Østersøen« (Op. cit. p. 11). Lignende Forhold gælde Pighvarren, hvis Æg ere endnu tungere end Rødspættens; de kræve i Følge Dr. Petersens Maalinger noget over 2 % Saltholdighed for at kunne flyde. — Det er særlig den østlige Del af Østersøen, dette gælder. I den vestlige Del er Vandet noget saltere, og Æggene synes der undtagelsesvis at kunne komme til Udvikling.

Paa Grundlag af dette ene Aars Erfaringer kunde disse mærkelige Forhold naturligvis ikke fremstilles som videnskabelig beviste, kun som højst

sandsynlige. For at faa Sagen undersøgt paany og yderligere suppleret, bleve de Undersøgelser foretagne, som her skulle refereres. Hovedformaalet var at faa konstateret, om der heller ikke i disse Aar fandtes smaa Rodspætteunger ved Bornholm og de øvrige danske Østersøkyster. Af Vigtighed var det ogsaa at faa undersøgt, om der fandtes Rodspætteæg i den østlige Del af Østersøen. Af Betydning for Afgørelsen af Spørgsmaalet, om Østersø-Rodspætterne ere indvandrede eller ej, vilde det være at faa konstateret, om der kan paavises Karakterer, hvori Østersø-Rodspætterne afvige fra Kattegat-Rodspætterne. Ved de Tællinger af Straaleantallet hos forskellige Flynderarter, som udførtes for om muligt derved at paavise bestemte Kendemærker for Ungerne af disse (se IV. Beretn. fra Biol. Stat., p. 128 f.), viste det sig, at der var nogen Forskel i Straaleantallet efter de forskellige Lokaliteter. At undersøge dette Forhold nærmere hos Rodspætten (og saa vidt muligt de andre Flynderarter) var ogsaa en af Opgaverne.

For Fremstillingen af Spørgsmaalet, om Rodspætten (og Pighvarren) kan udvikles i Østersøen eller ej, bliver det nødvendigt at give en kort Fremstilling af Østersøens Hydrografi paa Grundlag af Ekmans og Petterssons Undersøgelser*). Ved den store Mængde Vand, der gennem Floderne strømmer ud i Østersøen, fremkommer der en stadig udadgaaende Strøm fra Østersøen ud gennem Sundet og Bælterne. Dette svagt saltholdige Østersøvand danner Overstrømmen i Kattegat, den »baltiske Strøm«. Som Reaktionsstrøm danner det mere saltholdige Kattegatsvand en Understrøm, der gaar gennem Store Bælt, mellem Lolland og Femern, mellem Møen og Rügen, hen nord om Bornholm og videre ind i Østersøen. Der findes i Østersøen 5 store, mere eller mindre vel adskilte Dybdebassiner: Bornholmsdybet (25—50 Fv.), Danzigerdybet, »Østerdybet« (Øst for Gotland), »Nørredybet« (mellem Nordspidsen af Gotland og den finske Bugt) og Gotlandsrenden (alle 4 med Dybder paa over 50 Fv.). Helt adskilte fra disse er Aalandsdybet (50—135 Fv.), den botniske Bugts to Dybdebassiner (50—135 Fv.) og den botniske Vigs Dyb (25—65 Fv.). Naar nu Understrømmen naar hen til det første Dyb, ved Bornholms Østkyst, synker dette salte, tunge Vand ned deri og fylder det; kommer der mere af det salte Vand, end der behøves for at fylde dette Bassin, strømmer det videre til de næste Dybdebassiner. Paa den Maade blive de større Dybder i Østersøen fyldte med temmelig saltholdigt Vand. Paa den svenske hydrografiske Expedition 1877 fandtes der i Bornholmsdybet Vand af $1,_3$—$1,_6$ % Saltholdighed, i de øvrige Bassiner var der kun $0,_9$—$1,_2$ %. I Aalandsdybet og i de botniske Dybdebassiner er Saltholdigheden aldrig større end $0,_6$—$0,_7$ %. Ved de i Farvandene mellem Møen og Rügen foretagne Maalinger har det vist sig, at den

*) Ekman och Pettersson: Den svenska hydrografiska expeditionen år 1877. Kgl. Svenska Vetenskaps Akad.s Handl. Ny Följd. Bd. 25. 1892.

salte Understrøm ikke er konstant; til Tider strømmer der intet salt Vand ind i Østersøen. Enkelte Gange under exceptionelle Forhold kan der ogsaa trænge salt Vand ind i Østersøen gennem Øresund. Det salte Vand, der er sunket ned paa Bunden af de store Dybdebassiner, bliver staaende der uforandret og blander sig kun meget lidt med de øvre Vandlag. Ved de i 1893—94 foretagne Undersøgelser paa de samme Steder, som undersøgtes i 1877, viste det sig, at Saltmængden endnu var omtrent den samme, medens derimod Iltmængden var aftagen betydeligt (paa Grund af det organiske Liv*).

Som ovenfor omtalt have Rødspættæggene en Vægtfylde af $1{,}012$—$1{,}015$ (ved 10° C.), hvilket svarer til en Saltholdighed af $1{,}14$—$1{,}85$ %. De kunne altsaa ikke svæve i de øvre Vandlag i Østersøen**), hvis Vægtfylde kun er $1{,}006$—$1{,}007$. Den Vægtfylde, der kræves, findes derimod i det salte Bundvand; i Bornholmsdybet fandt den svenske Expedition i 1877 $1{,}696$ % ved en Temperatur af $2{,}8$°, hvilket svarer til en Vægtfylde af $1{,}014$. Udenfor Bornholmsdybet fandtes ikke større Saltholdighed end $1{,}219$ % ved en Temperatur af $3{,}1$° (i Østerdybet), hvilket svarer til en Vægtfylde af omtrent $1{,}011$. Øst for Bornholmsdybet kan man altsaa ikke vente at finde Rødspætteæg, der maa de synke til Bunds. Men i Bornholmsdybet kunne de svæve, der maatte man kunne vente at finde Rødspætteæg i det salte Bundvand. Det lykkedes ogsaa at finde Fiskeæg deri. Den 7de og 9de Maj 1894 fiskedes der i Dybet ved Christianso og udfor Gudhjem, og begge Steder viste der sig at være Fiskeæg i det saltere Bundvand, men ingen i de øvre Lag; der fandtes i det hele taget ikke Fiskeæg i Overfladevandet i Østersøen paa denne Tid. Den 10de Maj viste sig samme Forhold 14 Km. N. t. V. for Arkonas Fyr paa en Dybde af 25 Favne. Bundvandet havde her en Vægtfylde af $1{,}012$.

Det er nu Spørgsmaalet, hvad det var for Slags Æg. Nogle af Æggene vare smaa og indeholdt en Oliedraabe; det kan kun være Motellaæg, den stærke Pigmentering af Fostret viser det. De andre uden Oliedraaber kunne være Rødspætteæg eller Torskeæg. Skrubbe- og Isingæg kunde man ganske vist ogsaa tænke paa; men senere hen, i Juli Maaned, fandtes der mange Æg af 3 forskellige Slags ved Overfladen i Østersøen, og efter de i Juli Maaned 1894 i Østersøen foretagne Undersøgelser synes det at være Skrubbe-, Ising- og Brislingeæg. Hensen angiver ganske vist Isingæggenes Vægtfylde til $1{,}026$***), men senere†) har han selv fundet en ringere Vægtfylde for dem (hvor stor angives ikke), og formoder da, at de Æg, han tidligere har maalt, maaske ikke have været fuldt modne. — Naar Skrubbeæggene senere

*) O. Pettersson: Redogörelse för de svenska hydrografiska undersökningarne 1893—94. Bihang till Sv. Vetensk. Akad. Handl. Bd. 19. Afd. II.

**) Ved »Østersøen« menes stadig den østlige Østersø, begrænset af Linierne Kjøbenhavn—Malmø og Gjedser—Darsserort.

***) Vorkommen und Menge der Eier einige Ostseefische. IV. Bericht d. Comm. z. wiss. Unters. d. deutschen Meere in Kiel. 1877—81, p. 300.

†) Über die Bestimmung des Planktons. V. Bericht d. Comm. p. 40.

kunne findes ved Overfladen, kan der ikke godt være Tale om dem, da disse Æg kun fandtes i det salte Bundvand. Isingæggene ere saa smaa, at man ikke kan forvexle dem med vore andre Flynderarters Æg. Der bliver altsaa kun Rodspætte og Torsk tilbage at tænke paa. Aarstiden taler ikke meget for, at det er Rodspætteæg, da Rodspættens Legetid som bekendt falder i December—Marts, men der kunne jo være Efternølere; i 1881 fiskede Hensen Rodspætteæg i Tiden fra 23. April til 11. Maj*) — der kan altsaa findes Rodspætteæg paa denne Tid. Størrelsen af de Æg, der fiskedes, var $1{,}_{12}$—$1{,}_{11}$ mm; Rodspætteæg ere i Almindelighed noget større, c. 2 mm, de fleste af disse Æg ere da sikkert Torskeæg — maaske alle**). Om Torskeæggenes Vægtfylde siger Hensen, at ved $1{,}_{015}$ spec. Vægt ved $7{,}_{1}^{0}$ C. flød Halvdelen ovenpaa, men i det frie flod de ved en ringere Vægtfylde***). Det forholder sig da rimeligvis ogsaa med Torsken saaledes, at dens Æg kun kunne udvikles i det tunge Vand i Dybderne i Østersøen.

Det maa altsaa siges, at Rodspætteæg **ikke** med Sikkerhed ere konstaterede i den østlige Østersø.

I Begyndelsen af Juli 1894 fiskedes der igen i Østersøen omkring Bornholm. Som omtalt fandtes der paa denne Tid mange Fiskeæg i Overfladevandet, sandsynligvis Skrubbe-, Ising- og Brislingeæg. I Fald Pighvarreæg kunde svæve i Østersøvandet, skulde man vente at finde dem nu. Som allerede nævnt, fordrer de en større Saltholdighed, 2 %, for at kunne flyde, saa det var ikke paa Forhaand sandsynligt, at de skulde kunne findes der. Pighvarreæggene ere karakteriserede ved en Oliedraabe og vilde altsaa være lette at kende sikkert, hvis ikke en anden i Østersøen forekommende Fisk, hvis Æg ligeledes ere forsynede med en Oliedraabe og ere af omtrent samme Størrelse, netop ynglede paa samme Tid. Det er den 4-traadede Havkvabbe, *Motella cimbria*. Ved Mikroskopets Hjælp kan man dog temmelig sikkert skelne mellem de to Slags Æg, idet Motellaæggene ere noget mørkere; navnlig er Fostret i Motellaægget langt stærkere pigmenteret end Fostret i Pighvarreægget. — Der viste sig nu at være temmelig mange Æg med Oliedraaber i det salte Bundvand. De vare i alle mulige Udviklingsstadier fra første Begyndelse, indtil Ungerne lige skulde til at forlade Æghinden. (Den Tanke, om muligvis den ringere Iltmængde i Bundvandet skulde hindre Udviklingen, er dermed udelukket.) De i Spiritus opbevarede Æg vare ikke alle til at bestemme sikkert, men i alt Fald vare de fleste Motellaæg. Ved de i 1895 i Juli anstillede Undersøgelser, der gave samme Resultat med Hensyn til Æggenes Fordeling i Vandet, viste det sig, at næsten alle de med Oliedraabe forsynede Æg

*) Vorkommen u. Menge d. Eier etc. p. 300.

**) Det maa bemærkes, at vistnok ikke alle Æggene ere blevne maalte; største Delen bleve — om jeg husker ret — udtagne af Glassene og foreløbig undersøgte kort Tid efter, at de vare fangede, og ere da ved en Misforstaaelse ikke blevne opbevarede igjen.

***) Vorkommen u. Menge d. Eier etc. p. 305. Hensen bruger stadig Udtrykket »shwimmen» om Æggene; jeg har oversat det ved »flyde« eller »svæve«, hvilket jo er Meningen dermed.

vare Motellaæg, kun ganske enkelte syntes at være Pighvarreæg*. Resultatet bliver altsaa, at Pighvarreæg ikke, eller i alt Fald kun i meget ringe Antal, ere fundne i den østlige Østersø.

Paa denne Aarstid (Juli) skulde man vente at kunne finde Rødspætteungerne ved Bornholm, i Fald der vare saadanne. Jeg fiskede ivrig derefter, men uden Held. Dog blev der den Gang ikke fisket i Nærheden af Dueodde, hvor de bedste Steder for Flynderyngelen findes. Det maatte saa opsættes til hen i Slutningen af August; paa den Tid maatte man ogsaa vente at kunne finde Pighvarreunger der. Da jeg ikke selv var om Bord paa den Tid, paatog Kaptain Trolle og Lieutenant Jessen sig med stor Beredvillighed at søge efter dem, og deres Søgen kronedes med Held. Den 30te og 31te August fiskedes ved Dueodde og i Bugten Nord for Salthammerrev 26 Rødspætter, 24 Pighvarrer og 31 Skrubber af Aarets Yngel og enkelte fra forrige Aar. I 1895 fangede jeg i Juli Maaned ved Bornholm, trods ivrig Eftersøgen ialt kun 2 Rødspætter, 1 af Aarets Yngel 1″ lang, og 1 fra forrige Aar, $2^1/_2$″ lang. Af Pighvarrer fandtes ingen, derimod var der en Mængde Skrubber af Aarets Yngel. Der fiskedes meget netop paa de Steder, hvor Rødspætteyngel fandtes i 1894. Jeg skal her give en Oversigt over Resultatet af Fiskeriet efter 0- og 1-Gruppen af Flyndere ved de danske Østersøkyster i 1894 og 95.

1894. 2. Juli. Sandvigbugten. 6 Rødspætter, $2^1/_2$, $2^1/_4$, $2^1/_4$, 2, 2, 2″.
— 5. — Møllebugt ved Rønne. 1 Pighvar $2^1/_2$″.
— 6. — Faxebugt ved Sjælland. 1 Rødspætte 2″.
— 30.—31. August. Dueodde og Bugten Nord for Salthammerrev (Lieutenant Jessen). 27 Rødspætter, 24 Pighvarrer og 36 Skrubber.

Nedenstaaende Tabeller viser Størrelserne:

Rødspætter.	Pighvarrer.	Skrubber.
3 .	3 .	3 .
o	.	oo
.	o	oo
.	oo	o
2 o	2 oooooooooo	2 .
oooooooooooo	ooo	ooo
ooooooooo	oo	oooo
oooo	o	ooooooooooooo
1 .	1 oo	1 oooooooo
.	ooo	oo
.	.	.

1895. 22. Juli. Bugten Nord for Salthammerrev. 1 Rødspætte $2^1/_2$″, 105 Skrubber 13 paa $^1{}_2$″, 79 paa $^1{}_4$″, 11 paa 1″, 1 paa $1^1{}_4$″, 1 paa $2^1{}_4$″.
— 23. — Sandvigbugten. 1 Rødspætte 1″, 115 Skrubber (2 paa $^3/_8$″, 97 paa $^1{}_2$″, 15 paa $^3{}_4$″, 1 paa 1″.

*) Æggene bleve konserverede i Eddikesyre, hvori de holdt sig næsten fuldstændig klare.

1895. 26. Juli. Neden for Allinge. 12 Skrubber (7 paa $^1/_2$″, 5 paa $^3/_4$″).
— 26. — Snogebæk. 84 Skrubber (1 paa $^1/_2$″, 44 paa $^3/_4$″, 34 paa 1″, 5 paa $1^1{}_4$″).
— 29. — Faxebugt ved Sjælland. 3 Rødspætter, $2^1/_2$, $2^1/_2$, $2^1/_4$″, 24 Skrubber (1 paa $^3/_4$″, 7 paa 1″, 7 paa $1^1/_4$″, 1 paa $1^3/_4$″, 6 paa 2″, 1 paa $2^3{}_4$″, 1 paa 3″).
— 29. — Søhundehavn ved Møen. 3 Skrubber paa 1″.
— 30. — Præsto Fed. 4 Rødspætter, $2^1/_2$, $2^1/_2$, $2^1/_4$, $2^1/_4$″, 30 Skrubber 1 paa $^3{}_4$″, 6 paa 1″, 17 paa $1^1{}_4$″, 1 paa $1^1{}_2$″, 1 paa 2″, 2 paa $2^1{}_4$″, 2 paa $2^1{}_2$″).

At udtale noget sikkert om, hvorledes det forholder sig med denne Sag, om Østersøens Rødspætter (og Pighvarrer) i Almindelighed indvandre eller ej, er endnu ikke muligt; det foreliggende Materiale er ikke tilstrækkeligt dertil. Der blev i 1893 kun fanget 3 Rødspætter af 0-Gruppen ved Bornholm og 1 ved Falster mod Hundreder i Kattegat. I 1894 fangedes 26 Rødspætter af 0-Gruppen, 7 af 1-Gruppen (samt 24 Pighvarrer af 0-Gruppen, 1 af 1-Gruppen) ved Bornholm samt 1 Rødspætte af 1-Gruppen (?) ved Faxe. I 1895 fangedes kun 1 Rødspætte af 0-Gruppen og 1 af 1-Gruppen ved Bornholm samt 7 af 1-Gruppen ved Faxe og Præstø. Æg af Rødspætter og Pighvarrer ere ikke med Sikkerhed konstaterede i den østlige Østersø. De foreliggende Kendsgerninger tyde maaske paa, at der kun i visse Aar udvikles Rødspætter af nogen Betydning i Østersøen, saa at Østersøens Rødspættebestand sandsynligvis for største Delen rekruteres ved Indvandring fra Kattegat. Til en sikker Afgørelse af dette interessante Spørgsmaal ere fortsatte Undersøgelser nødvendige; for de ganske spæde Unger under $^1/_2$—1″ (og helst ogsaa Æggene) ere fundne der, kan man overhovedet ikke vide med Sikkerhed, om Rødspætten i det hele taget forplanter sig i disse Farvande.

Mine Iagttagelser over Fiskeæggenes Fordeling i Østersøen stemme godt med, hvad Hensen har fundet. I »Das Plankton der östlichen Ostsee und des Stettiner Hafs«*) siger han: »Ejendommelig var Fangsten af Fiskeæg. Jeg fangede saadanne næsten kun over Dybet mellem Memel og Gotland. Fra en Dybde af 140 m fik jeg 81, fra en Dybde længere østlig paa 130 m 30, derimod ved 2 Træk fra kun 30 m Dybde 1 og 2 Æg. Æggene havde et Gennemsnit af $1_{,13}$ mm; til hvilken Fiskeart de hørte, har jeg ikke kunnet udgrunde; de vare klare og indeholdt ingen Fedtdraaber. Efter dette Fund, og fordi jeg ellers intet Steds (— ved Bürsterort og Scholpin fik Hensen et Æg hvert Sted fra 80 m —) har fundet Æg, synes det mig utvivlsomt, at de væsentlig forekom i den dybe, tunge Understrøm. Dermed løses et Problem, som frembød sig for mig ved Undersøgelser over Forekomsten af svævende Æg. Jeg fandt, at Æggene af Pighvarre og Torsk i den vestlige Østersø endnu kun ved nogen-

*) Sechster Bericht d. Comm. z. wiss. Unters. d. deutsch. Meere in Kiel. Jahrg. 1887—91, p. 108.

lunde vægtfyldigt Vand formaar at svæve, at ogsaa Spermatozoerne kun i dette Vand vedblive at være bevægelige, og maatte forelægge mig det Spørgsmaal, hvorledes disse Fisk endnu kunde forplante sig i den østlige Østersø. Resultatet bliver nu, at naar disse Fisk begive sig hen til den kolde Understrøm for at lege, ville de finde den Saltholdighed, der fordres til Legningen.«

Det er altsaa Vægtfylden, der spiller saa stor en Rolle, ikke den større eller mindre Saltholdighed i og for sig, da det jo viser sig, at Fiskene selv godt kunne leve i Vand, der ikke er salt (vægtfyldigt) nok til at bære deres Æg — ja, Skrubben gaar jo som bekendt helt op i Ferskvand. Det har derfor stor Interesse at vide, hvor stor Vægtfylde de forskellige pelagiske Fiskeæg have. Hensen, Cunningham og Petersen*) have ydet vigtige Bidrag til dette Spørgsmaals Løsning. Om det nu er saaledes, at Rodspættens Æg overalt have gennemsnitlig samme Vægtfylde, kan man paa Forhaand ikke sige noget bestemt om; det er jo muligt, at Æggene af Østersø-Rodspætterne ere lettere end af Kattegat-Rodspætterne. Der har, som det i det følgende skal ses, vist sig at være en temmelig tydelig Forskel i Antallet af Finnestraaler hos Østersø- og Kattegat-Rodspætterne, saa det andet kan jo ogsaa tænkes at finde Sted. Det fortjener i alt Fald at undersøges. I Fald der virkelig er Pighvarreæg blandt de med Oliedraaber forsynede Æg fra Bornholmsdybet, maa en betydelig Forringelse af Vægtfylden have fundet Sted for disses Vedkommende, da Pighvarreæg jo ellers kræve 2 % Saltholdighed for at kunne flyde. Hensen har ogsaa tænkt sig denne Mulighed; i »Über das Vorkommen und die Menge der Eier einiger Ostseefische«, p. 305, siger han: »Derimod vil hinsides Rügen i den østlige Del af Østersøen vel aldrig den Saltholdighed, der er nødvendig for at Æggene kunne svæve, være til Stede, hvis ikke Æggene der antage en anden Vægtfylde.

Endnu et Spørgsmaal maa berøres angaaende disse Fiskeæg. Do de, naar de synke til Bunds? Hensen synes at mene, at de ogsaa kunne udvikles, naar de ligge paa Bunden, — hvis de da ikke blive fortærede. Han har ved en særlig dertil indrettet Skrabe fisket levende Æg fra Bunden, saaledes paa 18—20 m Dybde udenfor Mundingen af Kielerbugt, og han siger senere, at det derved er blevet »vist, at Æggene kunne udvikle sig saavel svævende som liggende paa Bunden«**). Jeg kan dog ikke indse, at dette er bevist, fordi Hensen har fundet levende Æg ved Bunden. Det kan jo være Æg, der nylig ere sunkne ned, og som maaske snart vilde dø, — eller de have sandsynligvis slet ikke ligget paa Bunden, men svævet i Vandet lige over Bunden. Det er meget usandsynligt, at Æg, der normalt flyde frit i Vandet, ogsaa skulde kunne udvikles, naar de ligge paa Bunden. Direkte Forsøg ere, saavidt jeg ved, hidtil ikke anstillede derover; men de vilde være af stor Interesse. —

Det er en almindelig Mening blandt Fiskerne, at Rødspætten i Østersøen er en anden »Art« end den i Kattegat — vel nærmest fordi Østersø-Rødspætterne

*) IV. Beretn. fra den Biol. Station, p. 28.
**) Vorkommen und Menge der Eier etc., p. 305.

ere mindre, magrere og smage anderledes end Kattegat-Rødspætterne. For om muligt at finde ud af, om der virkelig skulde være nogen egentlig, mere bestemt Forskel mellem de to Rødspætte-»Arter«, har jeg undersøgt en Mængde i Løbet af Sommeren 1894. Da jeg ikke har haft begge Slags samtidig, saa jeg direkte har kunnet sammenligne dem, har jeg ikke kunnet finde andet nemt brugeligt Forhold at holde mig til end Finnestraalernes Antal. Men da dette jo plejer at være temmelig konstant for hver Art, vilde det netop ogsaa være af særlig Interesse, om man kunde paavise nogen Forskel heri mellem Rødspætterne i Ostersøen og i Kattegat, — og dette har netop vist sig at være Tilfældet. Jeg skal her anføre disse Tællinger i en let overskuelig Form.

Af 137 Rødspætter fra den østlige Østersø fandtes:

75 Straaler i Rygfinnen hos	2 Exempl.	58 Straaler i Gatfinnen hos	1 Exempl.
74 — —	2 —	55 — —	1 —
73 — —	1 —	54 — —	11 —
72 — —	4 —	53 — —	13 —
71 — —	8 —	52 — —	23 —
70 — —	18 —	51 — —	21 —
69 — —	20 —	50 — —	25 —
68 — —	21 —	49 — —	22 —
67 — —	17 —	48 — —	9 —
66 — —	18 —	47 — —	6 —
65 — —	13 —	46 — —	2 —
64 — —	6 —	45 — —	1 —
63 — —	5 —	44 — —	2 —
62 — —	1 —		
61 — —	1 —		

Af 255 Rodspætter fra det nordlige Kattegat (regnet fra Linien Fornæs—Anholt) fandtes:

80 Straaler i Rygfinnen hos	1 Exempl.	61 Straaler i Gatfinnen hos	1 Exempl.
78 — —	4 —	60 — —	1 —
77 — —	4 —	59 — —	1 —
76 — —	8 —	58 — —	7 —
75 — —	14 —	57 — —	7 —
74 — —	27 —	56 — —	19 —
73 — —	20 —	55 — —	32 —
72 — —	32 —	54 — —	53 —
71 — —	36 —	53 — —	46 —
70 — —	30 —	52 — —	35 —
69 — —	27 —	51 — —	24 —
68 — —	21 —	50 — —	13 —
67 — —	9 —	49 — —	6 —
66 — —	6 —	48 — —	5 —
65 — —	6 —	47 — —	3 —
64 — —	6 —	46 — —	1 —
63 — —	3 —	44 — —	1 —
59 — —	1 —		

Det fremgaar heraf bestemt, at der i Almindelighed findes færre Straaler hos Osterso-Rodspætten end hos Kattegat-Rodspætten. Hos Østersø-Rodspætten er det hyppigste Straaletal i Rygfinnen 70—65, med Maximum ved 68, det hyppigste i Gatfinnen 52—49, med Maximum ved 50. Hos Kattegat-Rodspætterne er det hyppigste Straaletal i Rygfinnen 74—68, med Maximum ved 71, det hyppigste i Gatfinnen 56—51, med Maximum ved 54*).

Mine Undersogelser over Finnestraalernes Antal strakte sig ogsaa til de andre Flynderarter, men af ingen af disse har jeg haft tilstrækkeligt Materiale til at kunne konstatere, om her findes en lignende Forskel mellem Østersø- og Kattegatsformerne som hos Rodspætten. De Tal, jeg fandt, vare følgende:

Af 179 Skrubber fra den ostlige Osterso fandtes:

65	Straaler i Rygfinnen hos		1	Exempl.	46	Straaler i Gatfinnen hos		1	Exempl.
64	—	—	2	—	45	—	—	1	—
63	—	—	1	—	44	—	—	8	—
62	—	—	6	—	43	—	—	14	—
61	—	—	17	—	42	—	—	20	—
60	—	—	22	—	41	—	—	36	—
59	—	—	29	—	40	—	—	34	—
58	—	—	25	—	39	—	—	42	—
57	—	—	29	—	38	—	—	18	—
56	—	—	17	—	37	—	—	3	—
55	—	—	13	—	36	—	—	2	—
54	—	—	8	—					
53	—	—	7	—					
52	—	—	1	—					
51	—	—	1	—					

Af 36 Skrubber fra det sydlige Kattegat og den vestlige Osterso fandtes:

63	Straaler i Rygfinnen hos		1	Exempl.	43	Straaler i Gatfinnen hos		1	Exempl.
62	—	—	2	—	42	—	—	1	—
61	—	—	1	—	41	—	—	3	—
60	—	—	2	—	40	—	—	16	—
59	—	—	3	—	39	—	—	7	—
58	—	—	4	—	38	—	—	5	—
57	—	—	8	—	37	—	—	1	—
56	—	—	8	—	36	—	—	1	—
55	—	—	2	—	34	—	—	1	—
54	—	—	3	—					
52	—	—	2	—					

*) I Zoologischer Anzeiger 1895 Nr. 468 har G. Duncker givet en lille foreløbig Meddelelse om »Variation und Verwandschaft von *Pleuronectes flesus L.* und *Pl. platessa L.*« Før hans udførlige Afhandling foreligger, skal jeg ikke komme nærmere ind derpaa; men i alt Fald synes Duncker at være den første, der har gjort opmærksom paa dette Forhold med Finnestraalerne.

Af 24 Skrubber fra det nordlige Kattegat fandtes:

61	Straaler i Rygfinnen	hos 1	Exempl.	41	Straaler i Gatfinnen	hos 6	Exempl.
59	—	2	—	40	—	6	—
58	—	5	—	39	—	4	—
57	—	3	—	38	—	4	—
56	—	6	—	37	—	2	—
55	—	3	—	36	—	2	—
54	—	2	—				
53	—	2	—				

Af 36 Isinger fra den østlige Østersø fandtes:

75	Straaler i Rygfinnen	hos 1	Exempl.	58	Straaler i Gatfinnen	hos 1	Exempl.
73	—	3	—	57	—	1	—
72	—	3	—	56	—	2	—
71	-	6	-	55	-	5	
70	—	7	—	54	—	10	—
69	—	4	—	53	—	10	—
68	—	9	—	52	—	4	—
67	—	2	—	51	—	1	—
65	—	1	—	50	—	1	—
				49	—	1	—

Af 7 Isinger fra det sydlige Kattegat og den vestlige Østersø fandtes:

72	Straaler i Rygfinnen	hos 3	Exempl.	56	Straaler i Gatfinnen	hos 2	Exempl.
70	—	1	—	53	—	2	—
69	—	1	—	52	—	2	—
68	—	1	—	51	—	1	—
67	—	1	—				

Af 106 Isinger fra det nordlige Kattegat fandtes:

75	Straaler i Rygfinnen	hos 3	Exempl.	59	Straaler i Gatfinnen	hos 3	Exempl.
74	—	5	—	58	—	1	—
73	—	5	—	57	—	9	—
72	—	9	—	56	—	9	—
71	—	13	—	55	—	19	—
70	-	22		54	-	18	
69	—	16	—	53	—	19	—
68	—	15	—	52	—	20	—
67	-	8	—	51	—	8	-
66	-	4	—				
65	—	6	—				

Af 77 Pighvarrer fra den østlige Østersø fandtes:

67	Straaler i Rygfinnen	hos 3	Exempl.	51	Straaler i Gatfinnen	hos 1	Exempl.
66	—	4	—	48	—	3	—
65	—	3	—	47	—	16	—
64	—	7	—	46	—	19	—

63	Straaler i Rygfinnen hos		18	Exempl.	45	Straaler i Gatfinnen hos	17	Exempl.
62	—	—	12	—	44	—	11	—
61	—	—	14	—	43	—	6	—
60	—	—	7	—	42	—	2	—
59	—	—	5	—	41	—	1	—
58	—	—	2	—	40	—	1	—
57	—	—	1	—				
55	—	—	1	—				

Af 8 Pighvarrer fra det nordlige Kattegat fandtes:

65	Straaler i Rygfinnen hos		3	Exempl.	48	Straaler i Gatfinnen hos	1	Exempl.
63	—	—	2	—	47	—	1	—
62	—	—	1	—	46	—	3	—
60	—	—	2	—	45	—	1	—
					44	—	1	—
					42	—	1	—

Af 2 Slethvarrer fra det sydlige Kattegat fandtes:

79	Straaler i Rygfinnen hos		1	Exempl.	57	Straaler i Gatfinnen hos	1	Exempl.
75	—	—	1	—	54	—	1	—

Af 11 Slethvarrer fra det nordlige Kattegat fandtes:

80	Straaler i Rygfinnen hos		2	Exempl.	60	Straaler i Gatfinnen hos	1	Exempl.
79	—	—	3	—	58	—	1	—
78	—	—	1	—	57	—	1	—
77	—	—	1	—	55	—	6	—
76	—	—	1	—	54	—	1	—
75	—	—	1	—	53	—	1	—
73	—	—	1	—				
72	—	—	1	—				

Samtidig med at der fiskedes efter pelagiske Fiskeæg, benyttedes Lejligheden til at studere Planktonorganismernes Fordeling i Vandet Undersøgelserne herover ville blive offentliggjorte andet Steds; her kan kun gives et kort Resumé af Resultaterne. Det har vist sig, at Vægtfylden spiller en stor Rolle for adskillige Dyreformers Optræden i forskellige Vandlag. En Del Dyr ere saa tunge, at de kun kunne sveve i Vand, der har en Vægtfylde af $1{,}020$ eller mere — særlig de fligede Ribbegopler, *Bolina* og en anden Gople, en *Thaumantias*-Art*). Andre have en meget ringere Vægtfylde og kunne derfor

*) Direkte Maalinger af disse Dyrs Vægtfylde ere ikke foretagne, men det Faktum, at disse Dyr fandtes næsten allevegne, hvor Vandet havde en Vægtfylde af $1{,}020$ eller mere, lige meget i hvilken Dybde, men aldrig i Vand af ringere Vægtfylde, synes ikke at kunne tydes paa anden Maade.

findes i Vand af en langt ringere Vægtfylde (Saltholdighed). Paa Grund af de ejendommelige hydrografiske Forhold i vore Farvande kommer Vægtfylden til at spille en meget stor Rolle for disse Dyrs Udbredning. Et Dyr, der har en Vægtfylde af $1{,}_{020}$, vil jo kun kunne findes, hvor Vandet mindst har denne Vægtfylde, det vil derfor sjælden komme længere syd paa end i Kattegat. I Østersøen kan man ikke vente at finde saadanne Dyr, undtagen naar der en Gang imellem kommer særlig salt Vand derned. Det er ikke blot Fiskeæggene, men ogsaa mange andre Organismer, der ligesom Fiskeæggene svære frit i Vandet, hvis Udbredning er afhængig af Vægtfylden.

Ogsaa for de Dyr, der have frit svømmende Larver, men selv sidde fast eller kun langsomt bevæge sig langs Bunden, faar Vægtfylden Betydning. Kun hvor der findes Vand, vægtfyldigt nok til at bære Larverne, kan man vente at træffe de voxne Dyr, selv om disse sidste godt kunne leve i mindre salt Vand. Dette gælder navnlig Echinodermer, Snegle og Muslinger. Vor almindelige Søstjærne, *Asterias rubens*, kan leve i Østersøen; helt inde ved Jershöft (i Nærheden af Danzig) er der fundet nogle faa Exemplarer*). Men alligevel findes den i Regelen ikke i den østlige Østersø, og Grunden dertil er vistnok den, at Larvens Vægtfylde er ca. $1{,}_{013}$**). Vand af saa stor Vægtfylde forekommer kun sjælden i den østlige Østersø, og Larverne kunne altsaa heller ikke komme derhen. En enkelt Gang sker det, at der kommer usædvanlig saltholdigt Vand ind i Østersøen; ved en saadan Lejlighed ere uden Tvivl Larverne til de omtalte Exemplarer fra Jershöft komne derind. Der kan saaledes næppe være Tvivl om, at Grænserne for denne Søstjærnes Udbredning i vore Farvande bestemmes af dens Larves Vægtfylde; ogsaa paa mange andre Dyrs Udbredning har Vægtfylden uden Tvivl stor Indflydelse.

Kjøbenhavn i December 1895.

*) K. Brandt: Die auf der »Holsatia«-Expedition gesammelten Thiere. 6. Bericht d. Commiss. zur wiss. Unters. etc., p. 145.

**) Heller ikke for dette Dyrs Vedkommende ere direkte Maalinger af Vægtfylden anstillede, men jeg har ikke fundet den i Vand af ringere Vægtfylde, hvoraf man vel kan slutte, at dens Vægtfylde er omtrent af denne Størrelse.